Moderator: Good afternoon. Welcome to this news conference sponsored by Physicians for Social Responsibility. You will be hearing from three speakers today. Before we introduce them as a group and then individually, I want to invite the operator on the line to explain how the Q&A period will work.

Operator: Yes, ma'am. During the question and answer session you may ask a question by pressing star then one on your touchtone phone. If you'd like to remove yourself from the queue you may press star then two. Again, it's star then one to ask a question.

Moderator: Thank you, and we will invite the operator back on the line at the start of the Q&A period to repeat those instructions about how members of the news media can pose questions. As I mentioned, you'll be hearing from three speakers today: Dr. Ira Helfand, past president of Physicians for Social Responsibility and a nuclear expert who has dedicated his life to educating the public and the medical establishment about nuclear energy. He's published articles about the real and potential public health consequences associated with nuclear reactors, and he's a board certified internist in Springfield, Massachusetts, and a graduate of Harvard University and Albert Einstein Medical College.

Dr. David Richardson, associate professor of epidemiology in the School of Public Health at the University of North Carolina at Chapel Hill. His research focuses on ionizing radiation. He's engaged in studies of cancer among nuclear workers at several US Department of Energy facilities. In addition, he has worked with the World Health Organization's International Agency for Research on Cancer on studies of occupational cancers and ionizing radiation, and in Japan on studies of cancer among the survivors of the atomic bombings of Hiroshima and Nagasaki.

And the third is Dr. Marvin Reznikoff. He's an international consultant on radioactive waste issues. A nuclear physicist and a graduate of the University of Michigan, Dr. Reznikoff has worked on radioactive issues since his first project at West Valley, New York in 1974. His recent research focus has been on the risk of transporting and storing radioactive waste and the health impact of radioactive waste from oil and uranium production. In June 2000 he was appointed by the US Department of Energy Secretary Bill Richardson to a federal blue ribbon panel on alternatives to incineration.

Let's begin with our first speaker, Dr. Ira Helfand, past president of Physicians for Social Responsibility and a nuclear expert.

Ira Helfand: Thank you very much. There's been a lot of media attention over the last several days to the ambient radiation in and immediately around the plant, which is very appropriate, especially given our concerns about the workers who are remaining in the plant trying to bring this situation under control. But I think we need also to focus on the radioactive isotopes that are being dispersed at some distance from the plant, because this is going to cause a whole different set of health problems. We have been told by a number of nuclear experts who's been appearing in the press over the last several days that we will not see the kind of widespread dispersal of radiation that occurred at Chernobyl because there are not graphite bars to burn here, and the graphite fires played a very important role at Chernobyl in dispersing the radioactive material. But we have had fires already from burning spent fuel rods, and there have also been steam eruptions, explosions – I'm not sure what one would call them – that can play the same role in dispersing the radio isotopes to great distances. And once these are lofted into the air they get carried by the wind. Depending where the wind is blowing, they're going to get deposited, and this could be at some significant distance from the plant site.

We have to be concerned about this because even if the total radiation dose is not real high downwind from the plant, the concentration of these radioactive isotopes can pose a very serious health problem. Some of them are quite long lived. Some of them are shorter lived, like iodine-131. But strontium-90 has a half-life of 29 years, and once it's incorporated into bone it essentially stays with you for the rest of your life, irradiating the bone and the bone marrow and causing leukemia and bone cancer. Cesium-137 doesn't last in your body quite so long, but it has a very long half-life as well. And of course plutonium has the longest half-life of all these elements that we're concerned about at more than 24,000 years. And so the issue is that people at some removed from the plant may be exposed to very powerfully carcinogenic radio isotopes that may enter their bodies through inhalation or through ingestions from water or food, and that land at some significant distance may be contaminated so heavily with these materials that it cannot be used by humans for extend periods of time. There are areas, you know, more than 100 miles downwind from Chernobyl which are still not safe for people to use, and this is I think an aspect of the situation which we really need to be focusing on. If the winds blow, for example, in the direction of Tokyo, it is conceivable that significant portions of the Tokyo metropolitan area could be contaminated in this way if there is a large release as

this situation continues to unfold. And so I think this is something we really need to be focusing some attention on.

Moderator: Thank you. Again, that was our first speaker, Dr. Ira Helfand, past president of Physicians for Social Responsibility and a nuclear expert who's dedicated his life to educating the public and the medical establishment about nuclear energy.

That takes us to our second speaker, Dr. David Richardson, associate professor of epidemiology in the School of Public Health at the University of North Carolina at Chapel Hill, whose research focuses on ionizing radiation.

David Richardson: Thank you. I would – I think I would want to start by underscoring some of the points that were just made. On the one hand we have incredibly valiant efforts that are being made by the workers at the facility to deal with a really complex string of problems that continue to arise related to overheating, not only of the reactors but also of the cooling ponds. The workers are in a situation now where from an occupational safety and health perspective it's really serious. It's daunting. There are substantial non-radiological hazards: they're working in a facility where there's explosions going on and fires and extreme heat. And then we add to this some of the work areas have extremely high dose rates now, where workers have to be moved out of the work areas over short periods of time, I would imaging spanning minutes, in order to avoid problems of acute radiation poisoning. And over the period of time that they're working now they're going to accrue exceptionally high occupational doses of radiation, and this would be the external ionizing radiation which is radiation that's moving in the form of waves through the body, like X-rays, but in this case gamma radiation.

What's received may be – there's been a lot of focus on environmental releases related to the reactors and the question of will or will not the containments around the reactors hold and serve to mitigate the environmental releases. What's got less attention, and I would suggest that the press has taken their eye off the ball somewhat on this issue, is the ponds that are holding the spent fuel, which have – for these boiling water reactor designs have a relatively thin amount of containment. And for several of the pools those have been damaged or entirely blown off, and that's what I think – there's a large amount of radiation, radioactive material that's stored in those ponds, and I believe we can – the evidence is that we're having releases from those.

Now that's different than the primary radiological concerns that the workers in the facilities are facing. It's not exposure externally to radiation in the form of radiation waves or a beam of radiation, of gamma rays. It's the concern about the intakes of radioactive particles in the form of gases or dusts, that they may inhale or ingest, or later on if you would get a skin cut you could take it internally through a puncture of the skin. And how much of that's going to be released? We still don't know in the end, and figuring that out's going to be extremely complicated. I think given that most of offsite monitors are not functioning, it may require that we make an inventory at the end of this about what's still left in the plant, and by that we can make a reckoning of what was lost.

The other question is going to be where will it go, and that's – as people have said before, it's going to depend in part on the winds, whether they're moving out to sea or they're moving over land. And it's unlikely that the radioactive material is going to be distributed evenly in concentric circles; rather it's going to be deposited very likely in narrow bands. So it's going to be quite a while before we have anything more than a crude understanding of the magnitude and the distribution of that contamination, but it's – we're going to need to be able to do that in order to help inform people about how to minimize their exposures. So it's an extremely serious situation. Thank you.

Moderator: Thank you. Again, that was the opening statement of Dr. David Richardson, associate professor of epidemiology in the School of Public Health at the University of North Carolina, whose research focuses on ionizing radiation.

Let's proceed now to our third and final speaker making brief opening comments. Dr. Marvin Reznikoff is an international consultant on radioactive waste issues and a nuclear physicist and graduate of the University of Michigan. Dr. Reznikoff?

Marvin Reznikoff: Thank you, and good day, everyone. I'm going to try to fill in some of the points that were made previously by the other speakers. Let me start by saying that there are two hazards that have been explained. One is from reactors where there have been steam explosions, and the other is from the fuel pools. The steam explosions have released iodine gas and cesium-137. Cesium-137, because that's a semi-volatile metal, and once the cladding to the fuel is broken that material can be released along with the iodine gas, so when the steam is released then these materials are also released.

I have looked over the NOAA forecasts to see what the wind will be over the next three days. They actually have forecasts for the next seven days but three days is more reliable. And I think we're fortunate in that much of the wind will be going out from west to east, that is will be going out over the ocean. As was pointed out earlier, the Chernobyl hazard was about a 1,000 mile hazard, but over the ocean to reach the United States is approximately 2,000 miles. So material will be deposited along the way and rain will also take out some of this material, so I think in that sense we're fortunate. But material will also land in the ocean, and that means that marine life will pick up this material. And if fish – people eat fish, then they will in turn intake this material. Fortunately the Japanese government has evacuated a larger zone, so the hazard is less to people.

Let me say a word about the fuel pools. You've probably seen that these fuel pools are not located on the ground. They are located up near the top of the reactor, so that generally puts them 70 or 80 feet up in the air. With some of these buildings the roofs have been blown off, so the fuel pools are actually open to the environment directly. Also what hasn't been discussed very much is there is a standalone fuel pool at Fukushima that is on ground level and that contains most of the radioactive spent fuel. A lot of it has been shipped to the reprocessing plant at Rokkasho, but a lot of the fuel is actually sitting in this building, which does have windows. And I am not certain what happened when the tsunami hit, and it would be useful to have Tokyo Electric talk a little about that for the media.

Most fuel in the fuel pools, as I said, has been removed, but for Reactor 4 the fuel was removed from the reactor core and put into the fuel pool so that they could examine the reactor. And that fuel is relatively fresh and hotter thermally, so it's not surprising when the water is no longer circulating that it has been speculated that the water was actually boiled off and a zirconium exothermic reaction – that is the zirconium burned. It burns at 1,800 degrees Fahrenheit and releases hydrogen gas at that point. But the material – any material that got into the air would be directly released into the environment. They cannot resupply this reactor with helicopters because part of the roof still remains and they cannot just dump water into the fuel pool.

Those are essentially my statements, and I'm ready to answer questions.

Moderator: Thank you. Again, that was the opening statement of Dr. Marvin Reznikoff, an international consultant on radioactive waste issues and he's a nuclear physicist.

That takes us now to the Q&A portion of the call. I want to invite the operator back on the line to explain once again how the Q&A period will work.

Operator: At this time, if you would like to ask a question please press star then one on your touchtone phone. If you decide to withdraw your question, please press star then two to remove yourself from the list. We please ask that you limit yourself to one question and a single follow up. If you need to ask an additional question please know that you may press star then one to rejoin the queue.

Moderator: Thank you. And while we're waiting for our first question to line up, I want to emphasize that the Q&A period is for reporters only. You can find information related to this topic on the web at www.psr.org. Again, that's www.psr.org. Operator, can we proceed to our first question now?

Operator: Yes, ma'am. The first question comes from James Gland of *The New York Times*.

Question: Yes. Hello, can you hear me?

Operator: Yes.

Moderator: Yes.

Question: Okay, great. You gave a nice overview on both topics, the issue of exposure near and far from these reactors. Can you give us any numbers, say, in sort of Rems is, I guess, the favorite unit out there, in terms of what you're hearing or have heard are the levels at the reactor and far away from it, and how that turns into levels of danger ranging from radiation sickness to cancer risk? Anything? I'm not expecting an entire numerical overview. I know all these numbers aren't available, but we're having a hard time finding them and then also turning them into meaning when it comes to actual risk.

Ira Helfand: This is Ira Helfand speaking. In terms of the doses inside the reactor it seems to be varying dramatically from moment to moment. The highest that I've seen was a rate of about 40 Rems or four-tenths of a Sievert per hour at one point, which would have given people in that – who were working in the reactor site a dose

that would cause radiation sickness after two and a half hours of exposure. That level was not sustained for a long period of time.

As you get farther away I think the dose – the total dosage that people are getting is perhaps in some ways less important for the reasons we were talking about, several of us, during our presentations. It is unlikely, hopefully, that people at some remove from the reactor, say in Tokyo, are going to actually be exposed to high enough doses of total body radiation to cause them to have, you know, radiation sickness. But that doesn't mean that they're not inhaling or ingesting radioactive nuclides which might cause them to have cancer, and the correlation between them is not very good. You can have a very small total body radiation dose but inhale plutonium and end up getting lung cancer from it, or ingest some radio iodine and end up getting a thyroid cancer, or ingest some radioactive strontium and end up getting leukemia. And so this – the assurance that we're given that, well, the total dose of radiation that we're measuring is relatively low needs to be taken with that big grain of salt.

Question: Yeah. I mean, the one number we've got from Tokyo, .809 microsieverts, you know, as a reassuring number being given by the Tokyo government, is that a justified stance on that number given this cancer issue you mentioned?

Ira Helfand: And what I'm arguing is that it is not. It's certainly better that the dose there is low than that it were high, but the fact that the total body radiation dose is not high does not mean that people there are not being exposed to an increased risk of cancer.

David Richardson: To follow up on that a little bit, it matters right – there are several things that make you want to qualify or at least ask a question about what value they're reporting. If they're reporting, let's say, a measurement of gamma radiation activity one meter off the ground, that tells you about kind of the gamma field there at that location. The concern is that what's been released is not simply gamma-emitting radionuclides – there would also be beta emitters, for example – and that once they're taken into the body you're not so much interested in the amount of energy – so these units of Sievert or Rem are giving you a sense of what's the energy deposited per, let's say, kilogram or per unit mass. And we're not interested anymore once there's an uptake of a radionuclide which has proclivity to aggregate, for example, in the thyroid or the bone marrow. You want to know the dose delivered to a specific tissue, not the average dose when you're averaging over your total mass of your body. So there are several issues there. One is what's

being measured? Is it relevant to the radionuclides of concern? And then not – no longer talking about the average dose to the whole body, but the dose to a specific organ of interest.

Marvin Reznikoff: There's another issue – this is Marvin Resnikoff. There is another issue involved which is the total dose to the population; not just to the individual, but the total dose to all the individuals that are receiving this dose. When you get out past the 30-mile or 30-kilometer limit, then there are more people out there, and the total dose to the population will really tell you how many cancers might arise in the future.

I wanted to put this 400 millisievert number in another context, which is to compare that to a chest X-ray. Generally a chest X-ray is a tenth of a millisievert, and we are talking about 400 millisieverts per hour, so that's equivalent to 4,000 chest X-rays per hour.

Moderator: Okay. Operator, let's proceed to our next question.

Operator: The next question comes from David Brown with the *Washington Post*.

Question: Yeah, hi. My first question, which was actually partially answered, is do you have any suggestions on where the best source for measurements are? Because I'm also having a hard time finding them. So anyway, that's one, but the other one is can you address the risk, at least from – as seen in the Hiroshima – the atomic bomb survivors is surprisingly low in terms of fatal cancers over a long period of time. Between 1950 and '85 among 76,000 people that were followed in the LSS study – life something study – there's 300 excess cancers, which is obviously not a lot, and this is pretty heavy exposure. So can you sort of put your worries within the context of what's known from past high exposures?

Ira Helfand: Well, I think – this is Ira Helfand speaking – one thing I think to bear in mind is the enormous difference in scale in terms of the amount of radiation involved. Each one of these reactors has as much radioactivity as 1,000 Hiroshima-sized bombs, and the storage pools have several times more than that. So the potential amount of radiation that could be involved here if there is a large scale release, which there has not been yet, is literally orders of magnitude greater than the amount of radiation that was released at Hiroshima.

David Richardson: Your first question concerned where are the best sources of measurements. That information has, to my knowledge, been released relatively sporadically, and there's been occasional press conferences noting dose rates in certain areas for workers at the plants. There's not been a lot of information provided on environmental doses, and particularly kind of the information that would help you to understand the characteristics of the different radionuclides. So…

Question: Okay –

Marvin Reznikoff: And the reason – this is Marvin Resnikoff. And the reason is the monitors are located right at the site. What monitors are available have been put on the site, and the wind blows in various directions. It's generally from west to east, but you don't necessarily have a monitor where the plume is going. It's not clear that they have monitors located all around the circumference of this 30-kilometer area, so it's not surprising that we're not getting the numbers that we want.

Question: Okay, thanks.

David Richardson: One other follow-up regarding the lifespan study of atomic bomb survivors. It was – there are several aspects to this study that are important. It's an incredibly useful study for understanding what the risks of cancer are for people who have been exposed to radiation. It's worth noting that the study started in – 1950 is when they enumerated a census of survivors, so it's not giving you information about the risks of mortality following an atomic bombing. It's telling you about the risks of mortality among people who survived five years after an atomic bombing and then were subsequently followed. So it's an unusual study in the sense that follow up began quite a period of time after the exposure happened. So you might imagine that there was – there was; you don't have to imagine – an exceptional loss of life between the point of exposure and when the study begins to follow up people.

Another thing to understand is that the design of the study was intentionally over sampling people based on different exposure categories. So while there's 70,000 or actually more people who are enumerated in the cohort, most of them aren't high dose people. In fact, the majority of them are people who had lower doses so that they could have a comparison to draw between people who had higher and lower levels of exposure. So the net numbers of cancers among the five-year survivors of the atomic

bombing is in part a function of understanding the dose distribution among those survivors.

Moderator: Okay. Operator, let's proceed to the next question. I know we have a number in the queue.

Operator: Yes, ma'am. The next one comes from Deborah Zabarenko of Reuters News.

Question: Hi, and thanks for having this call. I'm going to guess that I'm among those who seem rather overwhelmed with the amount of information that we have and underwhelmed with the amount of specificity that we're having. A popular question to ask these days seems to be what the worst-case scenario would be, so let me narrow that down. First, do we agree that the most troubling reactor is troublesome Reactor 4? And if we do, what's the worst-case scenario for what might happen there?

Marvin Reznikoff: This is Marvin Reznikoff. Reactor 4 has – all the fuel was taken out of the reactor, was put in the fuel pool. And I'm just looking at it, and the fuel pool contains approximately 135 tons of nuclear fuel right now. It's likely that that material is – apparently there now have been two fires at that particular location and they cannot resupply the water from the air, so it's not clear how they're going to keep that pool cool. So that pool may actually – this exothermic reaction where zirconium actually heats up the area further, workers cannot get close to it because the direct gamma radiation coming off the pool is very high when the fuel is uncovered. Water in the pool serves as shielding and cooling, and when that water is gone the direct gamma radiation is very high. So it's not clear how they're going to recover, you know, that particular situation.

So I would have to go back and do the calculation as to what would happen if 270-some tons of fuel actually began to burn. I don't know the answer to that off the top of my head.

Question: I guess I want to make sure that I've heard things right and that that's the most troubling area right now.

Ira Helfand: Well, they're all kind of troubling, and one other that is particularly cause of concern of course is Reactor 3, where the government has reported that there's been some breach of containment. And this is particularly disturbing because Reactor 3 is fueled with MOX fuel, not just uranium, and the possibility of a very significant plutonium release and subsequent plutonium

contamination of area around the plant, which would really make this a very, very long term problem, is a big issue at Reactor 3.

Question: Okay, and one – I'm sorry, I'm going to squeeze one more in. How long is this likely to play out in terms of fires, in terms of nobody being able to get in to resupply water? Is this a weeks-long problem? Is this a days-long problem? Is this a months-long problem? I guess that's one question I'd like to see answered.

Marvin Reznikoff: Well, this is a several months-problem. The heat will be that high for months, high enough to cause an exothermic reaction. So this is not – this is going to be a continual problem for months.

Question: Thank you.

Operator: The next question we have comes from Tom Maugh of the *Los Angeles Times*.

Question: You say there's 135 tons of fuel in the spent fuel pool. How much is in a reactor itself?

Marvin Reznikoff: I don't really know the answer, but less – less than 135. I don't – I don't have the answer right in front of me.

Question: Okay. The follow-up question: You say there are not many monitors around the plant. Were they destroyed by the tsunami or were they just not installed in the first place?

Marvin Reznikoff: Again, this is an assumption on my part, that they were wiped out. I don't really – this is a conjecture – and that they have temporary monitors located there right now. I don't – but I'm not exactly certain on that, I have to say.

Moderator: Okay, thank you. Operator, let's proceed to the next question.

Operator: Yes, ma'am. The next one comes from Hiramati Yoshotomi of *Maniti Newspapers*.

Question: Thank you for taking my question. I have a question to Dr. Ira Helfand. You were talking about contamination risk in terms of isotopes, but Japanese people were informed by Japanese government radiation dose like as of 15th maximum 330 micro_____ or microsievert, as of 16th maximum 80 micro____ or microsievert. So I do not understand well how what you said is related to the kind of radiation dose, _____ of radiation dose. And

the government says it doesn't affect people's health, but you said serious potential risks. So could you please elaborate more?

Ira Helfand: Sure. Two points I think need to be made. One is that the repeated assurances that this dose is too low to affect people's health simply does not square with what we know about radiation, which is that no dose is safe, that there's no threshold dose, that any dose of radiation increases somewhat your chance of developing a cancer. So that's the first point.

The second point is that there is a very poor correlation, as Dr. Richardson was explaining before, between the total body dose of radiation that may be measured and the dose that's delivered to a particular susceptible tissue, so that if you are exposed to a relatively low dose of total body radiation but you inhale some particles of plutonium you can still go ahead and get lung cancer. And obviously if the total body dose is high, the chances of your ingesting or inhaling a radioisotope are greater because there's more of the material in the area. But this sort of linear relationship between your dose of total body radiation and the effect on your health is really lose when you're talking about low dose radiation at some distance from the source, because the internal dose may be very significant even if the total body dose of your entire body is not. Did that explain it?

Question: Well, how was the – your isotopes, the long term effect you were talking about?

Ira Helfand: I mean the various particles of the different isotopes that are released. There are nearly 200 different radioactive isotopes released potentially from the reactor. There are a few of them that are particularly important because of their biological activity and their radioactive properties: iodine-131 because it concentrates in thyroid and causes thyroid cancer, strontium-90 because it concentrates in bone and causes bone cancer and leukemia, cesium-137 because it's very prevalent and is widely dispersed throughout your body in all tissues and therefore can irradiate any part of your body, and plutonium-239 because of its extreme carcinogenicity in very low doses and because of its very long half-life. And that causes primarily lung cancer when it's inhaled; if it's ingested it's usually not a problem. But if it's aerosolized and you inhale the plutonium you are at significant risk for lung cancer at a very, very low dose of inhalation, which would give your – if they were measuring the total body dose from that plutonium might be very low. But the dose delivered to the

vulnerable part of your – the tubes leading to your lungs, the bronchi, would be enough to cause cancer.

Marvin Reznikoff: This is Marvin Reznikoff. It's important to point out just so that we're in the same ballpark with units the general background radiation – except for radon – is on the order of 1,000 microsieverts per year. So whatever the Japanese government is telling you, you need to compare it to the microsieverts per year, not the microsieverts per hour.

Moderator: Okay. Operator, let's proceed to our next question.

Operator: The next question comes from Jenny Uechi of the *Vancouver Observer*.

Question: Hi, my name is Jenny and I'd just like to ask a question. I've been keeping in contact with Japanese relatives and reading up on the Japanese news as well, but they seem to be quite reassured that – as the person from _____ *News* was saying, that it's not going to affect their health at this moment. In your view, would the radiation released at present be affecting the health – you know, is this true, is what I'd like to know. Are they safe in places like Tokyo and in the south of Japan in terms of radiation affecting people's health?

Ira Helfand: Well, I – this is Ira Helfand speaking again. Again, the doses of radiation that have been released so far in this accident have been relatively small, and the health effects to people as far away as Tokyo presumably is quite low, but it's not zero. The real concern is that the situation remains completely out of control at this point and that the releases that we might see in the coming days could result in a much higher exposure to populations even as far away as Tokyo.

Question: Mm-hmm. But the government seems to have been reassuring people that there is no need for leaving Japan or leaving places near that area at this moment, but do you feel that there's been not enough information about the risks in the Japanese media so far?

Ira Helfand: Well, it's very difficult to remove large numbers of people from an area. I think the government has acted prudently in removing people from the evacuation zone out to 20 kilometers and taking additional precautions out to 30 kilometers. Hopefully that will be adequate, and since you don't know which way the wind's going to blow it's hard to know where else you would evacuate beyond the immediate area. The danger, of course, is if there's a major release

where the winds are blowing from northeast to southwest. That radiation's going to blow down onto Tokyo, and we just can't predict that. As Professor Reznikoff was saying, this process, this radiation leak could go on for months. During that time, there may be periods when the wind is blowing in the wrong direction and large amounts of radiation are released. This is a terribly difficult situation with a lot of uncertainties as to how exactly it's going to play out.

Question: I see. Thank you.

Moderator: Operator, let us please proceed to our next question.

Operator: The next question comes from Sam Tranum of the *Nuclear Intelligence Weekly*.

Question: Hi, this is Sam. Thanks for having this call. I noticed that you had a number for the amount of spent fuel in the pool at Unit 4, and I'm just wondering where you got that number. I was hoping to find out how much spent fuel is in the other pools onsite.

Marvin Resnikoff: Yes, I have numbers for all the pools from Tokyo Electric.

Question: Oh, great. Are they on the website? I was looking around there. I couldn't find them.

Marvin Reznikoff: Well, I can – I just can go through them rather quickly.

Question: Great.

Marvin Reznikoff: Reactor 1 – this is what's in the fuel pool. Reactor 1, 50 – this is all in tons – Reactor 2, 82; Reactor 3, 88; Reactor 4, 135; Reactor 5, 142; Reactor 6, 151, and in the separate fuel pool that's sitting at ground level, 1,097 tons.

Question: Great, thank you. I also wanted to ask you about –

Marvin Resnikoff: There's also some material in dry storage, I should mention: 70 tons.

Question: Okay. I also wanted to ask you – thank you very much for that. I also wanted to ask you about the possibility of a zirconium fire. I've heard some people talk about this, but I was reading the NEI fact sheet on the spent fuel pool situation and they said that studies performed by the Department of Energy indicate that it is virtually impossible to ignite zirconium tubing. So where's the disconnect

between people talking about how if the pool drains you could have a zirconium fire and the NEI saying that's not possible?

Marvin Reznikoff: It appears possible. *(Laughter)*

Ira Helfand: The disconnect seems to be reality. It appears that this has happened to some degree already.

Question: Okay. Thank you very – oh, one other. If there is a zirconium fire, how do you put it out? Does just pouring water on it put it out, if that's possible?

Marvin Reznikoff: Yes, cool it down below the temperature. Yes.

Question: Okay. Thanks very much.

Moderator: Okay. Operator, let's proceed to our next question.

Operator: Yes, ma'am. The next question comes from Sandi Doughton of the *Seattle Times*.

Question: Hi, thanks for having this briefing. I'm – you know, you were talking about the kind of lack of monitoring even immediately around the reactors. If there is a large release and radionuclides begin migrating, who's going to be tracking that?

David Richardson: I think that's a very good question. Right now there's – as far as I understand they have malfunctioning monitoring posts, and the Nuclear and Industry Safety Agency doesn't know when they'll be back up in operation. So it would not be monitoring in a sense of having environmental radiation monitors onsite and deriving your exposure estimates from that sort of information. It would be much less ideal than that. As I said, it might require doing an inventory of what was released, trying to figure out the time sequence of releases, and then taking into account the topography and wind and doing kind of local dispersion modeling, which is a long, drawn-out process. It's not something that would be done promptly, which means that you're left with sort of crude estimates of kind of the average – you know, average releases over large kind of circles drawn, concentric circles. And that's not really reflective of the exposure that a particular individual in a particular place may receive. So yes, there's a huge gap right now in the information kind of – as far as I can tell on what can be done to do environmental dose estimation or reconstruction.

Question: And just a follow-up. Obviously the risk is much less to people in the United States, but in the case of a plume coming across the Pacific Ocean, once again, do you have to wait until it, you know, hits – goes above onshore monitors, or is there likely to be any kind of aerial monitoring at that point?

Marvin Reznikoff: This is Marvin Reznikoff. The time for material to get across the ocean is on the order of five to eight days. I don't know whether that's useful to you, but once you begin to see whatever results are coming – whatever material is coming over to the United States in that time period. It looks like from the NOAA maps that Alaska and then Canada will be first, and then – and then as – you'll get down to Seattle. And we should be able to detect what's coming across.

David Richardson: My sense right now is that, I mean, most of our focus of attention and concern is more local than that, and that the exposures and the environmental contamination of greatest concern right now that we're talking about are those that are not distributed globally but those that are distributed locally in Japan.

Ira Helfand: If I could just add to that also, I mean, I think it's obviously understandable that people here in the United States are concerned about potential risks here, but I think the real lesson for us to draw from this is what's happening in Japan, and do we court the same risk here in the United States from a future accident at one of our own plants.

Question: Thanks.

Moderator: Okay. Operator, let's please proceed to our next question.

Operator: Yes, the next question comes from Marilynn Marchione of the AP.

Question: Hi, thank you very much. Dr. Helfand, I find your biography that says you have made a career of writing – you're an internal medicine doctor. You've made a career of writing about the risks of nuclear power, and I just would like all three of you to please state if you have any personal opinions or if Physicians for Social Responsibility has a position for or against nuclear power, nuclear plants – just want to have all this on the table.

Ira Helfand: Sure. No, PSR is very clear in its position. We believe that nuclear power poses an unacceptable risk to public health, both because of the danger of catastrophic accident, which we're witnessing now in Japan, and because of the unsolved problem of

what to do with the long-term storage of waste, and perhaps most importantly because of the extraordinary role that nuclear power plays in furthering the proliferation of nuclear weapons. We have been in the United States promoting the dissemination of nuclear power technology around the world, and that technology has been in use in the nuclear weapons programs of a number of countries that we are now very worried about. And for all of these reasons PSR since 1978 has had a clear and explicit position against the further development of nuclear power, which position has been supported by broad segments of the American medical community.

Question: Thanks very, very much.

Ira Helfand: Sure.

Moderator: Thank you. Operator, let's proceed to our next question.

Operator: Yes, ma'am. The next one comes from Allison Rose Levy of the *Huffington Post*.

Question: Thank you. Thank you very much – excellent information here. Understanding your point that the most immediate concerns are local and in Japan, but also kind of extending a little bit the question from the reporter from Seattle, if this exposure continues and as we're told over many months, you know, this is going to continue to develop or, you know, if a worst case scenario evolves, would there be – you know, not simply toward the West Coast of the United States, which would be, you know, the most immediate sort of next recipient of plumes or anything coming in via air patterns, but in terms of, you know, the entire globe even, you know, with these kinds of materials and gases circulating, would there be any overall global effect, you know, in terms of water, air, overall radioactivity? I know this is a really big question, but just to ask it, if this process in this location kind of continues unabated or worsens.

David Richardson: I can answer in a sort of historical sense, is that yes, we currently have – some part of what we call our background radiation exposure involves the release of radionuclides from the use of nuclear technologies. So we've had a history of nuclear weapons testing, in a few cases nuclear weapons use in Hiroshima and Nagasaki. We've had unintentional releases of radionuclides at commercial plants and weapons factories, and they've contributed to what you would say are detectable levels, albeit small, of radionuclides in the soil and the air and the water. So yes, presumably we'll make a contribution to that. Again, I – as I said,

I think the primary concern right now is not about kind of the global background level of radiation and an incremental increase in that so much as – from my point of view anyway – the kind of more local concerns in Japan.

Question: Mm-hmm. Can I ask a follow up to what, which is, you know, the statements that it's not the level but the level of dose that is absorbed by a particular tissue or part of the body, where would one find some of the scientific research articles that talk about that? Because it seems that part of, you know, the kind of health communication message around all of this is, you know, the sense that it has to be a high dose, and – you know, so understanding of, you know, how a small low dose in the wrong place can lead to a health impact? Is there any – where would be the existing body of literature on that?

David Richardson: One place to look would be the National Academies – what's called the BEIR VII report, Health Effects of Exposure to Low Levels of Ionizing Radiation. The most recent one is the BEIR VII, and it would lay out the general principles for understanding that at least the way that we're – most current radiation protection models are developed is with the idea that the carcinogenic risks of ionizing radiation – the probability with the likelihood that you're going to cause a cancer is proportional to the dose of ionizing radiation, so that as you increase exposure to radiation you're going to increase the likelihood that you'll cause damage to a cell, which will be a stepping stone to a subsequent cancer. And – now that's sort of the idea that there's not a threshold, that there's a certain level where we say there's no health effect; rather, we say that the risk is proportional to the dose. The question about whether the proper dose metric to talk about is an estimate of your total dose divided by your total mass as opposed to a dose to a specific organ gets more into a more complicated field, which is kind of how you describe the radiation doses for internally deposited radionuclides. And there they tend to irradiate locally; that is, they're taking up and they'll reside in a piece of tissue or a target organ and they'll just irradiate locally, or they'll deposit most of the dose to an area that's smaller, and so you want to understand the dose to that organ. And most of the effects will be observed in the organs that have been locally irradiated. Now there are some exceptions to that, things like tritium, which tend to move around like radiated water, and they'll – they can, like water in your body, be distributed almost across the whole body. But those are sort of exceptional.

Question: Mm-hmm. Thank you.

Marvin Reznikoff: Just to add to – this is Marvin Reznikoff. Just to add to that, for example, strontium-90 would concentrate in the bone, and then you would be concerned about the leukemia effect. Iodine would concentrate in the thyroid so you'd be concerned about thyroid cancer.

Moderator: Okay, great. Operator, let's proceed to our next question.

Operator: The next question comes from Jesse Emspak with the *International Business Times*.

Question: Hi, guys. Yeah, a quick one was the – you mentioned earlier the spent fuel pools and how much is in them and that there's a risk of zirconium fire. And we had the question regarding the NEI position that you can't ignite zirconium alloy, and I was wondering is this – and you're saying the disconnect is reality. And I just wanted to make sure that – do we know for sure that that's what's burning, and if so what the evidence was that that's the case? And then the sort of next operative question is how many plants in the US are using a similar design and how many of those are located near fault lines? 'Cause it seems to me that if you've got, you know, what amounts to a great big swimming pool full of spent fuel elevated you need pumps to keep it going. So, you know, how many in the plants here might end up being in a similar situation if they get hit with a very large earthquake?

Ira Helfand: Well, there are 23 plants in the United States that are exactly of the same design as the Fukushima Reactor 1, and I'm not sure which of those are located near identified fault lines. I think that one of the more interesting articles that's appeared in the last couple days was sort of an assessment of which reactors are most at risk of earthquake damage, and it turns out it's not the ones in California. It's Indian Point north of New York City, and then a reactor here in Massachusetts were the two that were felt to have the highest risk of earthquake because of the relatively less strenuous design criteria that they were held to, so – to answer that part of your question.

David Richardson: Regarding the spent fuel pools, I think I would refer you – there's a really useful report called Safety and Security of Commercial Spent Nuclear Fuel Storage. It's National Academies, at press in 2006, so it's by the National Research Council of the National Academies. And it's got a chapter – it's the third chapter of that book where they lay out in detail kind of how what they call a cladding fire will evolve, and they describe both the chemistry of it

and describe scenarios. So I think it's actually – it's not really contested.

Question: Well, the follow-up I'm going to ask, the situation now then, we've got – you're saying it's going to last for a certain amount – I mean, you have a situation – how long would it ordinarily sort of burn for if you can't put any more water on it? I mean, there's only a limited amount of time I think they can keep the seawater going, and that's pretty corrosive anyway. So the question then becomes what – I guess, again, you're sort of asking worst case. Okay, let the stuff burn. You were saying it's several weeks that that could keep going and releasing stuff into the air?

Marvin Reznikoff: This is Marvin Reznikoff. The fuel in the fuel pools in Reactor 4, 5, and 6 is relatively fresh because they shut down those reactors, they removed all the fuel from the reactors and put them into the fuel pool, so that fuel is hotter. If you're asking the question at what point will it not – will the fuel pool not be able to reach a temperature of 1,800 degrees Fahrenheit where this exothermic reaction takes place, I'd have to, you know, do some calculations. I don't know the answer to that off the top of my head. But this fuel is relatively fresh that's in Reactor 4 fuel pool.

Ira Helfand: See, part of the problem here is that there might be a sequence of bad events. There could be a fire at one of the reactor pools – one of the storage pools this week, but the need to cool the other pools is ongoing so we could have another problem three or four weeks from now if at that point we lose the ability to adequately cool the pools. And the problems of increasing radiation – radioactive contamination around and within the plant site are going to make it increasingly difficult, not easier, for people to move about in there and do work and continue to control the situation. And I think that's what got everybody who's working on trying to actually control the situation so disturbed and upset, because there seems to be no way of quickly bringing this to closure, and the longer it persists the more potential problems can develop.

Marvin Reznikoff: The fuel pool – this is Marvin Reznikoff. The fuel pool is not located at the same level as where they are putting water into the reactor. The fuel pool is located 70 or 80 feet up and not where they're trying to relieve the pressure in the reactors. So it makes a more difficult situation to actually do both.

Moderator: Okay. Operator, let's proceed to our next question.

Operator: Yes, ma'am. The next question comes from Nancy Gaarder of the *Omaha*, Nebraska *World-Herald*.

Question: Yes, Ira, you said that each reactor has the equivalent of 1,000 Hiroshima bombs, the spent fuel pools several times that, and so the potential release is orders of magnitude. Are you saying that there's a plausible possibility over the next coming months that we could have Hiroshima-type releases of many thousand times? And then if that were to happen, what can we expect in the US and what should we be doing? And how would we know? How would we know that it – you talked about we'd know from Alaska to Canada, but how will we know that? Thank you.

Ira Helfand: Well, we certainly – we could have releases that are 1,000 times as much as Hiroshima. That's a real possibility. At Chernobyl I believe it was about 400 Hiroshima equivalents of radiation that were released, and we're dealing here with, you know, four reactors and five storage pools. There is an enormous, enormous inventory of radioactive material here that is potentially at risk. How would we know about it? Well, we will be monitoring – I mean, if there's a major release that's going to be picked up very quickly, as the spikes have been picked up over the last couple of days. And I assume that the United States has the technical means to track a plume of radiation even over the Pacific. We have planes with sensors that are part – and we have the whole system put in place to detect radioactive releases from nuclear tests as part of the regimen that was established to implement the Comprehensive Test Ban Treaty should it ever go into effect. So there are the technical means to monitor and track these releases.

Question: And then the follow up question would be is there anything Americans should be doing to prepare in any way? I know we hear about people snapping up those pills on the West Coast. And then if you had family in Tokyo, would you ask them to leave? And that's my questions.

Ira Helfand: If I had family in Tokyo I'm not sure what I would tell them to do, and I'm not sure where I would urge them to go to. And I know that's a really bad answer to a very legitimate question, but that's the best I can do on that one. I'm sorry, the other question was?

Marvin Reznikoff: Let me just add to what was said. I just wanted everyone to understand why there are so much more inventory in these reactor than released by the Hiroshima bomb. The Hiroshima bomb had fissions on the order of milliseconds, but – and that produced the cesium and strontium. But these reactors have fuel that's sitting in

the reactor for three years continuing to fission, so there are many more fissions and much more fission products than occurred in the Hiroshima bomb.

David Richardson: If I could follow up on that also, I'd like to just make clear we're not saying that there's a – a nuclear explosion is going to occur. We're talking about the mass of material which is there, and it would be distributed in a way that would be different than happened in Hiroshima and Nagasaki, where there was a prompt explosion. More likely what's happening here is that there are fires, a lot of the material may stay very – stay in place or may burn and some of it aerosolize, and – but it's – the comparison being made is in terms of volume, not in terms of the type of explosion that's going to occur or something like that. These are fires and not nuclear explosions that we're talking about.

Ira Helfand: Exactly.

Moderator: Okay. Operator, let's proceed to our next question.

Operator: Yes, and that comes from Sandi Doughton of the *Seattle Times*.

Question: Hi. Do you know if any of the reactors in the United States use the MOX fuel? And the second part of that, how dangerous is even a slight exposure to plutonium? I mean, can you get lung cancer from a single particle?

Ira Helfand: I can answer that second question. You can get lung cancer from a single particle of plutonium, depending on how large it is. The carcinogenic dose is felt to be measured in micrograms, millionths of a gram. Marvin, did you want to answer her first question?

Question: Which is do we have any MOX fuel reactors in the United States?

Marvin Reznikoff: This is Marvin Reznikoff, and I don't know the answer to that.

Question: Okay.

Ira Helfand: Sorry, this is Ira Helfand. My understanding is that we do not have any commercial reactors that use MOX fuel. There may be research reactors, but I do not believe that we have any commercial reactors using MOX fuel. But I'm not 100 percent certain of that.

Question: Okay, thank you.

Moderator: And, Sandi, this is the moderator. I can check on that with some additional experts that I know and I can get back to you on that.

Question: Great, thank you.

Moderator: And, operator, I believe we have one last question. Let's please proceed to that.

Operator: Yes, ma'am, and it comes from David Brown with the *Washington Post*.

Question: Hi, yeah. Just getting back to these estimates of the amount of radioactivity that was released in various events, I have in front of me the Human Radiation Experiments report – the final report of the President's advisory committee in 1996. There's a chart, and it mentions that at Chernobyl approximately 20 million curies were released. And it says in the first A-bombs, Hiroshima and Nagasaki, approximately 250 million curies released. But Dr. Helfand or someone said earlier that Chernobyl was, like, 400 times Hiroshima – so anyway, could you clarify that?

Ira Helfand: Yeah. I mean, I think – I'm not sure of those figures, and I believe that the release at Chernobyl was substantially larger than Hiroshima. Part of the difference is that much of the radiation at Hiroshima was direct radiation emanating from the explosion itself as opposed to the isotopes that were distributed afterwards. There is a direct blast of radiation that comes out when there is a fission explosion, and what we're talking about at Chernobyl is the radioactive isotopes with their longer half-lives that are distributed from an accident of that type. There was not a nuclear explosion at Chernobyl and so there was not that burst of radiation coming out directly from the explosion itself.

Marvin Reznikoff: So the comparison – this is Marvin Resnikoff. So the comparison is with the longer lived material, such as cesium, and if you look at that and compare Chernobyl to the Hiroshima blast, then the numbers are greatly different.

Question: Okay, thanks.

Moderator: Okay. I wanted to make sure that you know where to get more information from today's news event. You can contact Ailis Wolf at 703-276-3265 to be connected with any of the speaker you've heard from today. As I had mentioned before you can get information on this topic on the web at www.psr.org, and that's

also where streaming audio replay of this news event will be available later today.

I'd like to thank our experts for joining us today. You've been listening to a news conference sponsored by Physicians for Social Responsibility. Thank you for joining us, and that concludes today's news event.

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