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'The Rachel Maddow Show' for Tuesday, March 15th, 2011

Read the transcript to the Tuesday show

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Guests: Robert Bazell, Chris Jansing, Frank Von Hippel, Arnold Gundersen

LAWRENCE O'DONNELL, HOST: THE RACHEL MADDOW SHOW is up next with more on the crisis in Japan.

Good evening, Rachel.

RACHEL MADDOW, HOST: Good evening, Lawrence. Thanks very much for that.

And thanks to you at home for staying with us for the next hour. We were looking today for up close footage of the kind of technology and material, the actual physical stuff that is going so wrong right now in that Japanese nuclear power plant we have learned so much about in the last few days. One thing that we found in our tape archives is fairly amazing piece of footage from Anne Thompson, from NBC's chief environmental affairs correspondent. This aired on NBC "Nightly News" right after Barack Obama was elected president back in 2008.

I want you to check out just a little piece of it. What Anne is setting up here, what she's talking about, she's setting up discussion about the politics of nuclear power in the United States. But what I want you to focus on is what she is showing as she is setting this

up. Watch.

(BEGIN VIDEO CLIP)

ANNE THOMPSON, NBC NEWS CHIEF ENVIRONMENTAL AFFAIRS CORRESPONDENT:

This is a rare look at an assembly line of what some see as America's energy future, the components of nuclear power. Tiny uranium pellets fill 12-foot long rods. Bundled together, they become assemblies. Inside reactors, the assembly's active engine, creating nuclear energy for up to six years. Once finished, they are highly radioactive waste that could be dangerous for thousands of years, and that's the problem. How do you dispose of nuclear waste?

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(END VIDEO CLIP)

MADDOW: Actually, how you dispose of that stuff is just one problem with it. There's a whole different problem that is happening now. But seeing it being built like that is helpful for understanding what we're dealing with.

You saw these little pellets of uranium, right? They are similar between like tootsie roll size and Cadbury egg-sized uranium pellets. Those uranium pellets are stacked inside these thin, 12 foot long tubes.

They are metal tubes, basically just filled with pellets of uranium.

That's what we call fuel rods.

And that's essentially the business end of a nuclear reactor. Big long fuel rods like that mounted vertically, are inserted into a steel containment vessel. What's happening inside when the reactor is going is a nuclear reaction, nuclear fission, atoms splitting. But instead of creating a nuclear explosion, it is a controlled reaction. Instead of blowing up, the nuclear reaction creates a lot of heat, and the heat is what we are after, because the heat is what these reactors use to make a whole lot of electricity.

To make that nuclear reaction that makes that heat, those uranium pellets are the fuel. And just like any fuel, it gets used up eventually. Your 12-foot long fuel rod full of those uranium pellets, lasts about six years in a

reactor. With the reactor in effect turned on, the fission process over about six years uses that uranium fuel up. It becomes something they call spent fuel.

And when they call it spent fuel, what they mean is that it is degraded enough that even though it's still wicked radioactive, it is no longer efficient for doing what nuclear power plants are supposed to do, which is generating a lot of heat, boiling a bunch of water, making a bunch of steam that spins a bunch of turbines that make electricity.

So, here's the problem—after you've gotten your good six years out of your uranium pellet-filled fuel rods, what do you do with them? What do you do with your expired fuel? What do you do with that spent fuel rod?

Even after it's been taken out of service, it is still incredibly hot. I mean, thermally hot, like touching the stove hot. But it's also very, very

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radioactive.

What you do with it, is you put these hot, really radioactive fuel rods underwater. You put them in pools that in the case of these Japanese reactors that we are focusing on, are pools that are about 40 feet by 45 feet.

First of all, water just physically cools down the fuel rods. But the water also provides some shielding for their radioactivity, just like with an active reactor that has to get shut for some reason, these spent fuel rods essentially need to be treated the same way. They're so hot that they need to be kept underwater. And the water can't just sit there either, it needs to be circulating so it is cooling these rods off. If the cooling system stops and the rods are hot enough, if that water stops circulating, the fuel rods are so hot, they will boil off the still water that is covering them.

And if the rods boil off the water that is covering them, so the water level drops and the fuel rods get exposed to the air, what happens? Same thing as in an active reactor that's been shut down. It's not good.

The uranium, remember, is little pellets that are inside these long metal tubes. If those tubes are exposed to the air, the metal oxidizes and starts to breakdown. These pipes are not zirconium. But it's sort of like the same idea of rusting, right? It's not rusting. It's oxidization.

But you can understand it because we're all familiar with what happens when something

gets rusty, right? The metal breaks down, starts to degrade. If the bottom of your car looks like this, like mine does right now, you start to worry about whether or not you're going to need to replace the whole thing, whether you're going to need some framework done, or whether you just need a new car—rust.

The zirconium doesn't rust, but it does oxidized when it is exposed to air.

So, the combination of the heat and the oxidization, it's sort of like super-fast rusting. Exposing those zirconium fuel rods to the air causes oxidization to the metal holding on the uranium. It's like super-fast rusting on steroids, and that's trouble.

Between that oxidization and the heat, the metal starts to breakdown, that allows the uranium to get exposed. And the uranium so hot that it, too, begins to melt. The same thing

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that's true for fuel rods and active reactors that have to get shut down.

It's also true for spent fuel rods sitting in the pool. They're all hot and radioactive, right? These fuel rods have to be cooled for anywhere between five to 10 years before they're safe enough to be taken out of these pools and put into dry cast storage. Until they are safe enough for that, they need constant attention. They need a constantly operating cooling system to keep them covered up with that water, or we are talking about the same kind of meltdown that you see in an active reactor that has been shut down for some reason.

The difference is that with the spent fuel rods, it's probably worse. I realize this is a tough time to say worse. I'm not saying it to be upsetting. I'm saying it because I think it is frankly less upsetting to actually understand what's going on than it is not to understand.

And this is understandable. The reason spent fuel rods could be even more dangerous than a shutdown active nuclear reactor is because of two things. First: a spent fuel pool that loses its cooling system and has all of its water evaporate is a potentially greater source of a radiation leak than a reactor is simply because there are often more fuel rods in a spent fuel pool than there are in an active reactor.

The stuff has just to sit there for eight to 10 years, right? So, sometimes, they make it a lot of stuff just sitting there in the same pool, which means that there is a loss of cooling

system to that pool if there is a meltdown, there is more uranium to form a bigger radioactive mass that everybody hopes we don't have to contemplate.

The other reason, though, that spent fuel rods are potentially more dangerous even than a shutdown reactor is because of where the pools are. When a reactor shuts down, you have to worry about the cooling system over the fuel rods there. That's taking place inside an incredibly strong internal containment vessel. And that incredibly strong internal containment vessel—that's housed inside an incredibly strong external containment vessel.

One of the guests the other night described this as sort of a Russian doll type system. It's a containment vessel inside a containment vessel. The spent fuel poles that we've been talking about can be just as radioactive, can often have more fuel rods in them, but they're not necessarily kept in that Russian doll-style

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multiple containment system.

They don't want to move these fuel rods far from the reactors that they come out of. They are, of course, super hot and super radioactive. You don't really want to be trucking them across the country.

But in these reactors that are in trouble in Japan, where do they move those fuel rods to? They just move them to here. They just up top. They're essentially just protected by the one external containment wall. And that external containment wall is something that we're all very familiar with looking at pictures of right now—external containment walls that have been blown off from various explosions over the past few days.

This is the Daiichi nuclear plant in Fukushima we have been talking about. Reactors one, two, and three were on, were working when the earthquake hit on Friday. Because of the quake, they've shut down.

The difficulty in keeping cool, those shutdown-but-still-very-hot reactors is what we have been focusing on for the past few days. But there are three other reactors at Daiichi. We have not been talking about them as much because when the quake hit, they were not producing power. They were turned off already for maintenance.

What those three reactors have, the reason that we are talking about them now is because they have spent fuel pools—they have spent fuel pools inside them. And as far as we can

tell, those spent fuel pools are just protected by those outer containment walls, which had two fires and an explosion at one of these reactors with spent fuel pools continue, with a spent fuel pool in it.

We've had reports of the water level dropping at two other spent fuel pools. These are the spent fuel pools at Fukushima. There's trouble there keeping them cool, and there is a danger because of it.

At reactor four, there has been an explosion and there have now been two fires. We know that an explosion there cracked the roof. It appears that damage to the spent fuel rods is what is allowing for a release of radioactivity there.

Japanese authorities did report a large spike in radioactivity after the fire at number four. What that means is that either the force of that explosion or the smoke from the fire or both

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carried aloft radioactive particles being released by those damaged spent fuel rods, by those uranium pellets inside those big, now probably damaged metal tubes.

This is not a nuclear explosion. There are not nuclear chain reactions going on here. But this is a means by which radioactivity is being released into the atmosphere. And the question is whether or not those fuel rods, even if they're already damaged, whether they can be re-submerged.

Japanese officials today floated the idea of helicopters dropping water on them today. They raised the idea of fire trucks or fire hoses being used to get water on them today.

We're now going to turn to some expert help in trying to understand what the best hopes are for getting the situation under control.

Joining us now is nuclear physicist, Frank Von Hippel. He's the cofounder of the program on science and global security at Princeton University. He's also co-chair of the International Panel on Fissile Materials.

Mr. Von Hippel, thank you very much for being here. I really appreciate it.

FRANK VON HIPPEL, PRINCETON UNIVERSITY PROFESSOR: A pleasure.

MADDOW: Please tell me what I got wrong in that explanation.

VON HIPPEL: It was terrific. I don't think—the

one thing I guess I would differ on is probably it wouldn't—it wouldn't go all the way to meltdown in the pool.

MADDOW: OK.

VON HIPPEL: But it doesn't matter because the—long before that, the volatile radioactivity would have been driven off by the heat. You don't need to go to meltdown to release the radioactivity that we're concerned to, to the environment.

MADDOW: So, just the damage to the fuel rods which could happen just by them being exposed to the air is enough to release radioactivity. That's—that is the worst case.

VON HIPPEL: Yes, the crating around the uranium pellets, these zirconium tubes would burst. And at that point, the heat would drive off these—the boiling point of the elements that we're worried about is much below the

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temperature of the fuel—the fuel that we have at that point would drive it off into the atmosphere.

And the other thing is that, in fact, it's more than a crack in the roof of this facility. They are big holes in the walls, have been blown by that hydrogen explosion.

MADDOW: So, does that mean—with a crack to the roof but also big damage to the walls, does that mean any radiation being emitted from the damaged spent fuel rods is already just being emitted openly to the air?

VON HIPPEL: Pretty much. I mean, some of it might play out on the wall to cool, and some of it might be plating out on the walls. But there are big holes that a large fraction of it could escape from.

MADDOW: Can the spent fuel rods at number four be made safe? Do we know whether the damage done to that unit is the kind of damage that would prevent getting and keeping them submerged underwater from hereon out?

VON HIPPEL: As far as we know, the pool itself is intact.

MADDOW: OK.

VON HIPPEL: So if you can get water in it, and flood it above the level of the fuel rods, you would stop this process.

MADDOW: What if—what if the pool is leaking?

VON HIPPEL: By the way, we—you know, nobody knows what's going on out there. Nobody can go up because the radiation levels are so high. The roof is still intact, it hasn't been blown off as with units number one and three. So, so we are sort of—

MADDOW: We're hoping and guessing.

VON HIPPEL: -- everybody is guessing what the situation is there. But I think it's a pretty good, you know, deduction that the hydrogen was generated by the fuel, which means the hydrogen is generated at the same time the zirconium oxidizes.

MADDOW: As the sort of pipes breakdown, the metal rods breakdown, that releases hydrogen?

VON HIPPEL: Basically, what's happening is that the zirconium is taking the oxygen away from H₂O and leaving H₂ -- which then

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collects and leads into explosive levels.

MADDOW: If as they trying from as much distance as they can muster to get water onto those fuel rods, into that pool, if it turns out they are firing that water, in essence, into a colander instead of into a bowl, if there are leaks in that pool, then what?

VON HIPPEL: Then you really have a problem. You know, you can't prevent basically all of the volatile radioactivity from coming out and whatever fraction of it can go through the holes, you know, will go through the holes.

MADDOW: Yes. And if—in terms of what we know about capacity about how many fuel rods would likely be inside that reactor, what sort of quantity are we talking about, about radioactivity?

VON HIPPEL: I heard different numbers ranging from two to 15 reactor cores, you know, two to eight reactor cores worth—

MADDOW: So, if it can't be control, at worst scenario, eight reactors worth of radioactivity.

VON HIPPEL: Right.

(CROSSTALK)

VON HIPPEL: By the way, this has happened to unit number four is understandable and it's consistent with the theory it did dry out because the fuel from the unit number four was most recently discharged.

MADDOW: OK.

VON HIPPEL: And therefore, was the hottest. And therefore the water would have boiled of more rapidly from this. But units five and six are behind. They're coming along behind and will pose the same challenge.

MADDOW: Could the fuel rods—if there is a problem in which they can't get these re-submerged because there's been too much damage to number four, putting aside the worries about five and six right now—could they moved to an intact spent fuel pool somewhere else?

VON HIPPEL: I don't think so. I don't think—see any way in which people could actually manage to scoop that stuff up. You know, I think people are struggling with how to get water in there.

MADDOW: Yes.

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VON HIPPEL: So much easier to have water, you know, to get that in, and get this radioactive stuff out.

So, I think it has to be dealt—so I hope that the pool does hold water still.

MADDOW: Yes.

VON HIPPEL: There's no—nobody has suggested that it doesn't.

MADDOW: OK.

VON HIPPEL: And that it is just a lack of putting more water in that is the problem, and that's what they should work on.

MADDOW: If they are—let's say that the pool is intact, they are able to fill it up, looking at number five and number six where the water levels they say are dropping—are they going to be able to maintain some sort of cooling function there in a way that doesn't mean that this crisis is just indefinitely ongoing?

VON HIPPEL: Well, it will go on a long time. I mean, they will need a reliable source of water for these pools. You know, I thought you could take a hose up there with a helicopter or something like that.

MADDOW: Yes.

VON HIPPEL: They are talking about trying to shoot from a fire engine up through the holes. Part of the problem is actually that the wall hasn't blown away.

MADDOW: Yes.

VON HIPPEL: So, they don't have that kind of access.

MADDOW: They are trying to get through the walls—

VON HIPPEL: Or the roof, yes.

MADDOW: Through the crack that's on the roof, I see.

But to be clear, the people who are going to be doing this close up work with what's going on right there are really in grave danger themselves of radiation.

VON HIPPEL: Yes. And it's so radioactive up there that they couldn't really go in there. They have to somehow do it from the outside. I mean, we talked about helicopters or somehow shooting—trying to shoot a hose

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through that hole. And I think they really need to get some kind of cameras in there to see what's going on. As far as I can tell, they haven't yet.

MADDOW: Frank Von Hippel, nuclear physicist, cofounder of the program on Science and Global Security at Princeton and co-chair of the International Panel on Fissile Materials—you are helping me understand this, which does make me feel better. But this is a really bad situation. Thanks for helping us get through it. Appreciate it.

VON HIPPEL: All right. Appreciate it.

MADDOW: Another question that merits an attempt at explanation concerns exposure to radioactivity. What is in the clouds rising from these power plants, where is it going, what happens when it gets there? We'll try to clarify that issue. That, plus a live report from Japan, next.

(COMMERCIAL BREAK)

(BEGIN VIDEO CLIP)

ROHIT KACHROO, ITV NEWS REPORTER (voice-over): For some survivors of the quake and the tsunami, this is the test that might reveal the impacts on them of the third great crisis. They are some of the 140,000 people ordered to leave their small villages close to the Fukushima plant.

(on camera): This is the main road from Fukushima into Tokyo. It's the evening rush

hour and the traffic should be going in that direction. Instead, thousands of people are trying to get out of the town and into the main city.

(voice-over): Many traveled 150 miles to Tokyo because they didn't trust the government's 12-mile evacuation plan. And tonight, scientists warn that there might be some danger from radiation, even here.

(END VIDEO CLIP)

MADDOW: That was Rohit Kachroo of ITV News reporting.

Tokyo is where NBC's chief science correspondent Robert Bazell joins us from right now, tonight.

Good morning, Bob. Thank you so much for joining us. Really happy to have you with us.

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ROBERT BAZELL, NBC NEWS CHIEF SCIENCE CORRESPONDENT: My pleasure, Rachel.

MADDOW: One in 10 people in Japan lives in Tokyo, 13 million people in that city. What is your sense of how the city is coping as a large metropolis in this fifth day since the quake and the tsunami?

BAZELL: I don't think that there's not been some noticeable effect of anything coming to a halt. There are a lot of aftershocks. You feel an earthquake about twice a day here. But I don't think people are in any great panic. A lot of Japanese people wear masks to start with because there are fears of germs. So, maybe there's a few more wearing masks because of fear of radiation.

But I think most people trust that the government is telling the

truth, that the health danger from radiation here is minimal. There's a

lot of foreigners left the country, particularly people who can get to

other countries nearby here in Asia and get their families out, because of

not because there's a dangerous situation now, but because they're concerned that if there were to be a massive nuclear incident at the power plant, then, of course, everything would become very chaotic and they wouldn't be able to get out at all.

So, there's been a lot of that, crowding at train stations. The train service has been erratic at times because of confusion from the earthquake aftershocks, but there hasn't been a lot of—in my limited experience, that there has not been a lot of effect from the radiation here in Tokyo.

MADDOW: And in terms of that—I mean, the city government in Tokyo did report elevated radiation levels, but levels not so high that they pose any immediate health risk. You describe people as feeling not distrusting of their government's assurances about radiation levels. Do you have a sense—particularly with your scientific background, in how the fear of radiation, the fear of the nuclear disaster is still ongoing, is sort of interplaying with the rest of the traumatic impact of this disaster?

BAZELL: Well, it really is a horrible combination, of course, Rachel, to have a big fraction of a country wiped out by an

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earthquake, and then have a terrible tsunami, and then have this ongoing nuclear thing which has yet to be resolved and is now the second worst commercial reactor disaster ever after Chernobyl, and they still are not sure when it's going to be over. So, this is a country on edge.

In addition to that, the economy is tanking because one-third of the electricity is not being generated, and that's going to have long, long lasting economic effects on Japan.

So, I think that people are very worried about those kind of issues. And, of course, a lot of people have relatives up in the area that's affected. And so, there's a sense of just the exhaustion and malaise and trauma from so many things at once. And it's very hard to comprehend how bad that can be for people.

But I don't think anybody is worried about not trusting the government. I think that, you know, you're always going to find people who look for conspiracy theories, who think the government is not telling the truth, as not being forthcoming. And I have no way of knowing that they're not. I think everybody I talked to says that the government just has too much to lose if it comes out they were lying to people about what the true dangers were.

MADDOW: Bob, in terms of being able to report on this disaster—you and other journalists that you have talked with since you've been there, do you feel you are able to do your job and get out and report? Do you feel

safe to do so? Are you having to take precautions related to radiation?

BAZELL: Well, the radiation is an interesting—you talk about irrational fear of radiation. They say that at one time here radiation levels were 20 times above normal. Normal is very low, and 20 times above normal is about the amount you would get if you took an airplane trip from Los Angeles to New York. So, you're not talking about getting a huge amount of extra radiation from those kind of levels.

And, of course, radiation can do horrible things, and this is a country that because of America's actions in World War II suffered—the only country that had a nuclear attack on it. So, there's a special kind of lingering fear of nuclear stuff here.

But everybody has it. You can't see it, you can't feel it, and you don't understand it. So, it becomes much more fearful than perhaps

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other things that are more dangerous to you than the radiation. But—so, it's hard to say exactly what somebody should do if they can, just listen to the government and take adequate precautions.

MADDOW: NBC's chief science correspondent Robert Bazell in Tokyo for us tonight—thank you for joining us, Bob. Appreciate it.

BAZELL: Thank you.

MADDOW: Plumes of radioactive steam are escaping into the atmosphere in Japan. How radioactive are those plumes, where are they, where are they going next, and how can this all be kept in perspective? That and more, next.

(COMMERCIAL BREAK)

MADDOW: The ways we know that the nuclear fuel rods in these reactors in Japan have been damaged, the signs that that has happened, frankly, are all bad signs. But they're also pretty definitive, and more information is better than less information in a situation like this, OK?

First, the hydrogen explosions at these reactors—those are a sign that hydrogen was released as a byproduct of the fuel rods breaking down. So, that's one sign that the fuel rods are breaking down—those hydrogen explosions.

Also, the radioactivity they can detect in the air. That is also a sign that the fuel rods are breaking down. They're breaking down and

they are releasing radioactive particles from their radioactive fuel into the environment. Those are signs that tell us the fuel rods are breaking down.

But they do not tell us how much the fuel rods have been breaking down. Remember, there's a difference between some meltdown and a total meltdown. A partial meltdown means there has been some damage to the nuclear fuel. And, of course, authorities want to prevent more from occurring. A total meltdown means they haven't been able to control it, and the fuel turned into molten radioactive mass, which may be hard to contain by any means. It also means that any radioactive release from that nuclear fuel—from that damaged fuel has been maximized, if it's an uncontrolled meltdown.

So, they want to keep any meltdown partial and not total.

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Given that, how partial a meltdown are we talking about here? What has already happened in Japan? What proportion of nuclear fuel at the reactors is damaged so far?

The International Atomic Energy Commission said today in Vienna that at reactor number two at Daiichi, that's the one that had the explosion roughly this time yesterday, reactor number two, they thought there was damage, but the IAEA was estimating it to be less than 5 percent of the fuel in the reactor, less than 5 percent.

Unfortunately, TEPCO, the company that runs that plant, just about an hour ago significantly worsened that estimate. TEPCO now says that at—says that at reactor two, they think that one-third of the fuel rods at that reactor are damaged, 33 percent. They also say that at reactor one, they think the damage is 70 percent.

Again, a partial meltdown is not the same as a complete meltdown. But this is significant damage they are talking about now.

More ahead: live from Japan and from the experts. Stay with us.

(COMMERCIAL BREAK)

MADDOW: The nuclear reactor complex called Daiichi is located right here in the Japanese prefecture of Fukushima. It's about 60 miles from the city of Sendai, which is probably where pictures of some of the most brutal devastation you have seen from Friday's

earthquake and tsunami have come from. The plant is about 170 miles from Tokyo.

Because of radiation that has been released by the ongoing nuclear disaster at Daiichi, almost everyone that works at the plant has been evacuated. They are down to a skeleton crew of 50 very brave people who are taking great personal risk and who frankly the world is really counting on right now. An area of 20 kilometers, about 12 miles around Daiichi has been evacuated, people have been ordered to leave. And anybody between 20 and 30 kilometers, which is 12 to 19 miles from the plant, is being advised to make their homes as air-tight as possible and just stay indoors.

Authorities as far away as the great population center that is Tokyo have reported radiation levels that they describe as being as high as 20 times above normal for the city. And that, of course, sounds terrible and it certainly is not good, but it does not necessarily mean that is

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a level that's going to get anybody sick.

With radiation, it's the amount of radiation you are exposed to and how thoroughly you are exposed to it and it's how long you are exposed to it. I mean, you wouldn't want to go around being constantly chest x-rayed every day of your life. But the fear of radiation exposure from one x-ray is not going to stop you from getting one if your doctor says you need it.

It is worth understanding what is worth worrying about and what is not worth worrying about. And for the people in Japan, it is worth doing what they can to prevent unnecessary, significant exposure.

For example, out of desire to limit people's exposure to radiation in Japan, there were warnings today that accompanied the latest forecasts there for rain or snow in parts of that country. On Japanese television, people who lived near the Fukushima reactors were warned to keep their bodies covered up, to not let rain or snow touch their skin.

There are really three things to consider about the way that radiation is moving around Japan. One is, of course, just how much of it there is. There's just concern for the sheer amount of radiation that's going to end up in the atmosphere, that's why everybody is so focused on what is still happening at Daiichi.

The second concern is which way the wind is going to blow the radiation. Literally, how is the weather going to deliver the radiation

around Japan or off of its coast?

The third concern now is not just about the shutdown nuclear reactors at Daiichi, but also having those spent fuel rods emitting radiation. That in some cases may be spread by fire. Is that radiation source from the spent fuel rods a quantitatively or qualitatively new concern today? Is that potentially a worse radiation source in terms of human exposure than what we've already been worried about the past few days?

Joining us now is Arnold Gundersen. He's a former executive from the nuclear industry turned-safety-watchdog. He worked on cleanup after the Three Mile Island disaster in the 1980s, and on the class action lawsuit resulting from that disaster in the 1990s.

Mr. Gundersen, thank you very much for joining us tonight. I appreciate your time.

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ARNOLD GUNDERSEN, NUCLEAR ENGINEER:
Thank you for having me.

MADDOW: Are the leaks associated with this number four reactor potentially more dangerous than the leaks from the other three shutdown reactors? Are the radioactive particles released from a damaged spent fuel rod worse than what's released from damaged fuel rods and reactor that's just been shutdown?

GUNDERSEN: The damage from the fuel rods has long lived isotopes. You know, that fuel has been sitting around for a long time, and the short-lived isotopes like iodine are no longer there. So, what is there is cesium and strontium and plutonium and other long lived isotopes. What's happening in close to that reactor is probably really powerful gamma rays, that's like an x-ray. But when the fuel rods burn or when they become volatile like Dr. Von Hippel said, when that happens, now particles are released.

So, the particles are affecting people off site in the rain and falling on their clothing and things like that.

In close, my guess is that the biggest problem is direct gamma rays, direct x-rays coming out of the fuel pool.

MADDOW: Those would be the things of most concern to the people who are on-site at the nuclear facility, gamma radiation?

GUNDERSEN: That's correct.

MADDOW: OK. Let me just ask you to restate what you just said about radioactive particles. In terms of how radiation travels, where the weather takes it, what can you explain about the concerns here? Is it about breathing it in? Is it about the cloud traveling to other places and being brought down by the rain, for example? How does that work?

GUNDERSEN: Yes. You know, if you're downstream from a smoker directly, you're going to be right in the smell a lot. But if you're 10 feet to either side, you may just smell it a little.

And I think that's what's happening now. We are seeing wide variations in instrument readings. I don't think it's because the amount of radiation is pulsing. I think the same amount of radiation is coming out. But more likely the wind is pushing the plume to the left or pushing the plume to the right.

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It's very difficult to determine now, because remember, these things have exploded. Whatever radiation detectors were in these reactors are obliterated. So, now, experts are stuck chasing this radiation around the country.

And, you know, the aircraft carrier Reagan incidentally flew through -

drove through a plume out 100 miles at sea. They didn't know that was there. And so, the problem becomes where does that plume go, and where is it going next.

It looks like one bumped into Tokyo a few hours, but now has moved on. And the question is: where should they put the radiation detectors to give them the best idea about the magnitude of this problem?

MADDOW: If we could get better at tracking it, and that may happen over time, that may happen as more resources are devoted to that. Energy Secretary Steven Chu talked a little bit about that today in Congress. If we could get better at figuring out where these plumes were and where they were going—what could we do about it? Or is it just a matter of offering us warning and telling people to get out of the way if they need to?

GUNDERSEN: Well, it would definitely affect, you know, radiation evacuation planning. If there's one good thing that's happened in this event, most of the wind has been offshore. So, a combination of knowing where the plume is and knowing which way the wind is going to

come from would tell you whether, you know, perhaps the north side of the site should be evacuated or the south side.

It would help dramatically in evacuation planning to know better what's coming out of the plant and where the plumes are going.

MADDOW: In terms of your overall experience in the nuclear industry and your experience with recovery from Three Mile Island and the class action lawsuit thereafter—do you feel like the nuclear energy industry as a whole was prepared to deal with an incident of this magnitude? Or is this beyond the realm of anything that was ever imagined in worst-case scenarios for nuclear energy planning?

GUNDERSEN: No, it is not beyond the realm of what's ever been imagined. But, no, I don't think they are handling it as well as they could. There's a lot of similarities here to Three Mile Island—you know, underestimating the

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magnitude of the incident on the first day, for instance. That's a dead ringer for what happened at Three Mile Island.

Waiting for an evacuation for several days—that's a dead ringer for what happened at Three Mile Island.

But the difference is that Governor Thornburg at Three Mile Island did tell pregnant women and young children to evacuate, and I believe that the Japanese should do that out beyond this 20-kilometer or 12-mile zone. I think the Japanese should extend that warning for pregnant women and for children out to at least the 30 kilometer zone.

Being in your house with a developing fetus, for instance, is not a good idea because your cells are growing very fast, and it's fast growing cells that are more susceptible to radiation.

So, if I were the authorities there, I would suggest that pregnant women and young children leave further out, and they haven't.

MADDOW: Former nuclear energy executive, Arnold Gunderson—thank you very much for your time, sir.

GUNDERSEN: Thank you.

MADDOW: MSNBC's Chris Jansing, host of "JANSING AND COMPANY," is in Japan right now. Next on the show, she'll give us a live update on the disaster from Japan. And then there will be a full report at 11:00 p.m. Eastern

tonight following THE ED SHOW. The story is, of course, still developing.

Please stay with us.

(COMMERCIAL BREAK)

(BEGIN VIDEO CLIP)

JAMES MATES, ITV NEWS (voice-over): We stood amid the silence of Otsuchi, a looked from horizon to horizon. They were picking over the remains of a town that no longer exists. As if earthquake and tsunami were not enough, no sooner had the water retreated and then fire engulfed this town. Fueled by kerosene from cooking stoves and the wooden remains of thousands of houses, it burned for two days, and left nothing.

Walking through it now, the stench of smoke is still everywhere. On Friday morning of last week, this was home to 17,000 people. Only

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5,000 have been accounted for.

(on camera): The population was certainly aware of the danger, the sign warns that this is a tsunami inundation area. The trouble is it says the danger area ends here. In fact, the power of this tsunami wave took it for well over a mile further down this valley. It is no surprise that the poor people here were caught completely unaware.

(END VIDEO CLIP)

MADDOW: That was James Mates of ITV News reporting.

Joining us now live from Tokyo is MSNBC's Chris Jansing, host of

"JANSING AND COMPANY."

Chris, thanks very much for taking time to join us. I really appreciate it.

CHRIS JANSING, "JANSING AND COMPANY"
HOST: Hi, Rachel.

MADDOW: Hi. You know, even areas like Tokyo that weren't affected by the earthquake or by the tsunami are dealing with small earthquakes and rolling blackouts and potential radiation from this crippled nuclear plants. How do you sense that people are handling it?

JANSING: Well, there's definitely a growing sense of unease here. You know, you would think 150 miles away especially after the initial

days when there was a sense that there was no danger here, things would be OK. But there are a number of things that play in it, and it really has escalated over the last 24 hours with these reports of not just the fact that there were levels of radiation that were found here in Tokyo. Ten times normal.

But then reports that, you know, some U.S. service members were absolutely tested positive for having been exposed to radiation, that folks at two of the U.S. naval bases that are in the Tokyo area were asked to stay indoors. I mean, just these reports that continue to trickle out.

And I think you have to add into that, Rachel, the fact that there are growing concerns about whether or not the folks here know the entire story. It's not in the nature of the Japanese, necessarily, to strongly question these kinds of things but those questions are starting to be asked.

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And so, even here, a growing sense of unease and even if you could avoid those news reports, we continue to have these after shocks. There was a pretty big one several hours ago. Shook the building where I am right now.

So, there are these constant reminders everywhere you go, Rachel.

MADDOW: Is the government able to accomplish the basic facts of an authority in a situation like this? In terms of communicating with people, in terms of managing people's communication with one another, facilitating that—water, food, shelter, health care? Is the government exerting its basic authority skills?

JANSING: Well, look, the prime minister is on television. He's urging calm. They've deployed 100,000 members of the military. A lot of people were surprised when they accepted a lot of offers of outside help. At least 91 nations have said they would come in. I think there are now 10 to 12 different countries that have brought in search-and-rescue organizations.

But at least in the immediate area, the quake and the tsunami, it is an absolute logistical nightmare there. As you can imagine, it's dangerous. There are concerns about how far that danger zone goes in terms of radiation.

And so, it's clear that they have not been able to do everything that they need to do just to get the basics to those who have survived—

550,000 people still displaced by this. Many of them are still living in shelters and really looking just to get the basics.

You know, this is unprecedented. This is a country that was so well-prepared for an earthquake but the tsunami that followed, the devastation that followed, you know, just has been absolutely overwhelming, Rachel.

MADDOW: MSNBC's Chris Jansing—thank you for joining us tonight, Chris. I'm really looking forward to your special report later tonight.

JANSING: Thanks.

MADDOW: Chris will be anchoring a special live from Tokyo tonight at 11:00 p.m. Eastern immediately following "THE ED SHOW." I highly recommend you stick around for that tonight.

Some of the surprising assets of the United States that we have to bring to bear on this

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crisis that you might not have known about.
That's coming up.

(COMMERCIAL BREAK)

MADDOW: Here in the U.S., what we now know as the Department of Energy started life as the Atomic Energy Commission. It was created by Congress after World War II to design and produce and develop nuclear weapons.

The Atomic Energy Commission later turned into two other agencies, one that governed nuclear weapons, the other nuclear energy. Then in the late '70s, during our country's energy crisis, the two departments were combined once again into the Department of Energy.

So, the Energy Department doesn't just oversee America's nuclear industry today because nobody else wanted the job, the nuclear industry is why the Department of Energy exists at all—which is why today's long-scheduled House Appropriations Subcommittee hearing on the Department of Energy's budget turned into this detailed briefing from our nation's energy secretary on his department's and our nation's response to the nuclear elements of Japan's disaster right now.

(BEGIN VIDEO CLIP)

STEVEN CHU, ENERGY SECRETARY: We are positioning sequence management response teams in the U.S. consulates and military installations in Japan. These teams have the

skills, expertise, and equipment to help, assess, survey, monitor and sample areas. We sent our aerial measuring system capability, including detectors and analytical equipment to use and provide assessments for contamination on the ground. In total, this team includes 34 people.

The department's also monitoring activities through the Department of Energy Nuclear Incident Team and is employing assets at its national laboratories to provide ongoing predictive atmospheric modeling capabilities based on a variety of scenarios.

(END VIDEO CLIP)

MADDOW: Predictive atmospheric modeling capabilities—have you been thinking of the plumes of radiation being released at the Daiichi nuclear plant? So, has our Department of Energy. The department and the nuclear regulatory commission are monitoring the

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released radiation 24 hours a day, seven days a week, they say. The work is being done by meteorologists, nuclear scientists, and computer scientists based at the Lawrence Livermore National Laboratory in California.

If you are one of those scientists working on this project at the Lawrence Livermore lab—one: thank you for your service to our country, we are very glad that you do the work that you do. Two: please go back to work now.

Our nation's Nuclear Regulatory Commission has also set up, in effect, a 24-hour war room at their headquarters operation center in Rockville, Maryland. The U.S. has sent more personnel to help the Japan response overall than any other country. So far, it's 148 personnel and 12 rescue dogs. The U.S. Navy 7th Fleet is based in Japan. The Navy has the USS Ronald Reagan carrier strike group off Japan's east coast. Today, it flew 29 sorties for humanitarian aid, delivering 17 tons of supplies, food, water and blankets. Plus, an additional three sorties as part of the search-and-rescue efforts.

Some other American warships already headed to assist in Japan's northeast were instead sent to the west coast of the country because of rising radiation levels.

U.S. Navy aircraft were used today to fly two missions to survey debris fields out at sea. The military also says it's provided the Japanese government with two fire trucks.

No U.S. military personnel were lost in the

quake or the tsunami in Japan. All U.S. military personnel based in that country have been accounted for. That said, several sailors were given potassium iodide tablets today as a thyroid cancer preventative after they returned from flying humanitarian missions. Radiation detection equipment found evidence of low levels of radiation on either the sailors or their helicopters as well as a number of additional helicopter crews later in the day.

Our Navy says the humanitarian missions nevertheless will continue.

Now, it's time for "THE ED SHOW." Thanks for being with us tonight.

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