

# Nuclear Revival?

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**Greg Dalton:** Welcome to Climate One at The Commonwealth Club. I'm Greg Dalton. Today we're talking about the future of nuclear power in America. For the first time in 30 years, new nuclear plants are under construction in this country; two reactors in Georgia, and two more in South Carolina. Those plants are poised to benefit from \$8 billion in loan guarantees President Obama offered in 2010 for what he called, "A new generation of safe, clean nuclear power plants," but the Fukushima disaster in Japan and energy markets in the United States are making new nuclear a tough sell. For the next hour, we'll discuss America's commercial atomic reactors, plans to extend their operating life, as well as build new ones. Our conversation will include questions from our live audience here at the Commonwealth Club in San Francisco and three experts. On my right is Jim Boyd, former commissioner of the California Energy Commission and the state liaison to the Nuclear Regulatory Commission. In his -- on his right, is Marv Fertel, CEO of the Nuclear Energy Institute, which is a policy and trade association for the nuclear industry. And Joe Rubin is a reporter for Center for Investigative Journalism who has covered the nuclear industry. Please welcome them to Climate One.

[Applause]

**Greg Dalton:** Marv Fertel, let's begin with you. Why should the United States build new nuclear plants?

**Marv Fertel:** The first reason, Greg, is to make sure we have an adequate and reliable electricity supply because that's what nuclear plants produce.

The other reason is as we as a society move to a cleaner, less emission, particularly lower carbon, environment, nuclear is right now the only base load source of electricity that produces electricity 24/7 and produces no greenhouse gases or other air pollutants while we're doing it. So if we want reliable electricity, we want to maybe move to a cleaner environment when we produce it, nuclear is an important part of the mix, not the only thing, but a very important part of it.

**Greg Dalton:** Jim Boyd, new nuclear is intertwined with the question of extending the life of the existing nuclear power plants, and we'll get into that. But one of the issues that ought to be considered when extending the licensing timeframe for the country's existing nuclear power plants, what's at stake there?

**Jim Boyd:** Well I think, primarily the safety of the public. And the fact that plants were licensed for 40 years, the expected lifetime of all the components of the plants. And to extend them, as is happening, for another 20 years, one had best dig deeply into the condition of the plant, its ability to survive another 20 years, to not endanger anyone. And you know, with nuclear it's very, you know, high rewards alleged but incredibly high risk associated with anything going wrong. So if you're going to do that, and we've had a lot of experience in this country with the degradation of materials, the almost hole in the head of the Davis-Besse plant, the problems with rust and corrosion and leakage. And it doesn't even apply of late to old materials; we're having leakage right here in California in two-year-old materials. So I mean that to -- we in California is the question -- and it goes beyond materials. It goes into dealing with other threats, and Fukushima certainly reminds us of what threats are, and California being a highly active seismic area, as is Japan, we in California,

and I as a former commissioner, those are the types of things you think about and worry about and want investigated before policymakers make a decision to move forward.

That's all we asked for in California, that's all we suggested continuous to the NRC that they think about for us, but it's not a bad idea for the people as well.

**Greg Dalton:** And we'll drill down into a lot of those things later. Joe Rubin, what's at stake for new nuclear? You cover the industry, what are the key issues you think we have to talk about?

**Joe Rubin:** Well I mean I think that we're really a nation divided when it comes to nuclear energy. I mean if you look at what's been going on within the NRC itself. I mean following Fukushima, the Fukushima task force came up with some recommendations to make nuclear plants safer across the country, and basically the key is -- behind the go fast approach. And the other commissioners are on a go -- a slower approach, consulting more with the industry, more in the camp of any eye, and that has -- that completely blew up this year. The other commissioners accused Mr. Jaczko of bullying. I mean it was an ugly debate within the Congress. And he said that basically that they're -- what the other commissioners were doing is putting the safety of the public fundamentally at risk. And that we -- price should not -- the cost should not be a factor. So I mean I think when it -- I think the real issue right now is the old plants that we have in this country, the 104 reactors, all of which were started -- began construction before 1974. And many of them are aging; many of them have had problems such as Davis-Besse or Byron in Illinois.

And so I think it's a pretty troubled industry and I think that there's so many advancements going on in the area of renewables that, I mean, there's a lot of question marks I think around new nuclear power.

**Greg Dalton:** Marv Fertel, is it a troubled industry?

**Marv Fertel:** No, I don't think so. Though I agree with Jim, and I would agree with some of what Joe said, clearly safety is number one. But it's certainly not a troubled industry. Also to be honest with you, the plants aren't old in the way that they've been described. Everything in the nuclear plant that's moving, every valve, every pump, every motor is changed out through a predictive, preventive or corrective maintenance program. They're not old, some of them are newer than what you have in your car or we have on our airplanes that we fly. Also, issues like both Jim and Joe referenced, the Davis-Besse corrosion of the reactive vessel head, they were not implementing the program that the rest of the industry was implementing to control boric acid, that's why they had the problem. So the thing at the nuclear plant is that you got to do it -- you got to do right what you're supposed to be doing. And when you're doing that, the plant is a very safe, very good operating plant. I totally agree with what Jim said about on licensed renewal -- you got to make sure it's safe. To be honest, you got to make sure it's economic because to make it safe it may cost me so much I may decide it doesn't pay to go ahead and do that in some of the older plants, and you may see that at some point. But right now, what you're doing is you're implementing programs to make sure those plants are safe.

**Greg Dalton:** But there's 104 nuclear plants in the country, 71 of them the licenses had been renewed, another 32 are under review or intend to review, so far everybody who owns a nuclear plant says, "Yeah, we want to run this thing for another 20 years because it's cheaper than building a new one." But is it really -- does the NRC really dig into it and really proactively look for problems? Is the renewal process technically thorough enough?

**Marv Fertel:** It took the NRC about 10 years to define the renewal process. It takes them about three years to put you through the renewal process. What they look at are the systems that are not

already in what they call age degradation-type programs, so they're looking at things that aren't been looked at everyday as part of their normal stuff. Also Greg, what you have to keep in mind is you get a 20-year renewal, it does not say you can now operate 20 years and do whatever you want. They're still looking at you every day to make sure that you're operating safely. They can shut you down whenever they want to, and they can require you as you'll see in the post-Fukushima environment, to impose all kinds of new requirements. Joe referred to the difference of opinion between the chairman and the other four commissioners, and I would say the chairman called me right after their task force report came out. He said. "I think we should try and get the high priority things done in five years." I agree completely. Everybody is working through a five-year program. What the chairman wanted to do, which his colleagues didn't want to do, was he wanted to jump in and just say, we know what we needed to do, go do it and not get staff input. They had a report done by seven people. There's 4,000 people at the Nuclear Regulatory Commission with an awful lot of expertise. He wanted it to be fleshed out a little bit more with input from not only NEI, but stakeholders like the Union of Concerned Scientists and others, and that's what they've done and they've issued orders and a bunch of other things, subsequent to the last year's report.

**Greg Dalton:** Jim Boyd, you are the California liaison to the Nuclear Regulatory Commission. It started off as an enthusiastic, perhaps innovative regulatory agency, and then it changed. Tell us where did the NRC is today. Are they as proactive as Marv Fertel just described?

**Jim Boyd:** A different point of view. I certainly agree with your introduction. I think I've said it before that, you know, what's wrong with the NRC? Well they're not the young aggressive agency they were once, maybe bureaucratic malaise creeps in, I don't know.

But my concern is that they don't seem to respond to issues rapidly enough or thoroughly enough. And the point I want to make is the seismic issue here in California. When we raised the question about -- well, your -- when relicensing finally came up and one utility said, for sure we're going to relicense, the other said, we're thinking about it, we began to raise the issue of the additional seismic studies that probably should be done utilizing the most current seismic technologies. And after all Diablo Canyon went from a cost of under \$500 million to a cost near \$5 billion because they had to redesign, rebuild when they discovered the fault offshore. And as we argued about these studies, a few years back, another fault was discovered offshore. We suggested to the NRC, "You've got to look at the seismic activity before you relicense." They said, "We do not consider seismic issues in relicensing."

**Greg Dalton:** Wow. Is this before or after Fukushima?

**Jim Boyd:** This is before.

**Greg Dalton:** Before Fukushima.

**Jim Boyd:** And they said further, "We consider seismic issues every day," so to speak. Because under the ongoing license provisions, we look at anything that's going on, if somebody brings something to our attention, we'll look into it. And my only come back before the US Senate committee with the chairman sitting there also was, "We have been telling you for years, we have published immense documents, former Commissioner Geissman who's sitting in the audience right now and I commissioned the first study in 30 years of nuclear in California. And a lot of questions were raised, what more do you need to know you need to look at something?" and yet they didn't.

So to me, you know, California was on its own to look at California's issues and to see that something's done.

I don't think they're captives of the industry or anyone else. I just think they're caught in a

bureaucratic maze of rules and regulations that have eliminated their youthful vigor when they were a young agency that -- with you would think have them pursue more rigorously things that are going on.

**Greg Dalton:** Was Fukushima a wakeup call? What happened after Fukushima? Did the NRC then say, "Wow, we got to pay attention to all the seismic risk that created this."

**Jim Boyd:** Well, they certainly dove in with regard to Fukushima and what it represented, and they did their study and they had their recommendations, and seismic is certainly part of that recommendation process. And I cannot speak for them at the present time and Marv may know more what they're going to do with regard to the seismic studies that California says needs to be done. What Fukushima did for California, is prod the utilities into moving forward with the seismic studies that we had argued for years needed to be done. But whether NRC takes that into account in relicensing, that remains to be seen.

**Greg Dalton:** Joe Rubin, what is the US doing to prevent a Fukushima from happening here? Is the NRC on the job? Are they on the watch?

**Joe Rubin:** Well I think it's a big NRC. I mean there's about 4,500 employees of the NRC and I mean I think, you know, we interviewed Commissioner Jaczko for our documentary that we did for the Center for Investigative Reporting, and you know, I think he's very proud of those employees and I think he is a believer in nuclear power. But I think what's worth putting out is--

**Greg Dalton:** He's also gone.

**Joe Rubin:** He's also gone, yes. Yeah. But I -- you know I think his concern is basically that he feels that strong -- you know, being a real regulator is what will save nuclear power and make it robust, and make it be a part of our energy future. And I think that he really worries that we are, you know -- in a kind of bureaucratic way, he's not, you know -- if you're editing Commissioner Jaczko for a documentary, it's not -- there's not a lot of flashy comments.

But I think that he, you know, I think he's really concerned that we could be heading toward some kind of calamity here. I think what's really worth pointing out, you know, in terms of after Fukushima is that it's kind of an amazing story of what's happened in the entire world. I mean, Germany for example, which has the same proportion of nuclear power in their portfolio, about 20% as the United States. They are eliminating all nuclear power within the next 10 years, and they immediately took offline plants which are older than I think 30 years. So they're heading in a different direction. I think Germany is really important to talk about too because they are most akin to California, because Germany has such an aggressive program where -- I mean nowhere else is like it in the world in terms of their commitment toward renewables. And it's, I think worth mentioning just a couple weeks ago, they had for the first time 50% on a sunny day in Germany, there was solar -- the entire nation was powered by solar power. And so, I mean of course, there's a reliability issues with solar power, but it still shows I think how far they have come and how serious they are about replacing this power. They're also planning to put \$12 billion into the electricity grid to improve their ability to have more reliable solar, wind, biomass. So it's a real -- it's not just a simple world where it's, you know, we're going to be -- if we were to replace some of these plants where all of the sudden we're going to be living in the world where we're totally dependent on gas and coal, I don't think that the evidence actually bears that out.

**Greg Dalton:** Marv Fertel, Germany is a very technologically advanced country, great engineers, they build great cars, lots of great products, should the US do what Germany's doing on nuclear power?

**Marv Fertel:** No. And to be honest, I think Joe characterized what Germany is doing partially correctly. Before Germany decided to stop the nuclear program, Germany decided to continue to operate the plants for about another decade that was pre-Fukushima.

They imposed a tremendous tax on the utilities to do that. They were going to generate billions of Euros in taxes, and that's why they were going to do it. It was politically not very receptive within their country. After Fukushima, Merkel's party lost a very big state election almost immediately.

And immediately they made what is maybe a good decision for Germany, but certainly a political decision on what they're doing with nuclear. They're buying a lot of nuclear electricity from the French. That may have been the only sunny day in Germany. Germany is not known for sun. So for solar to do it there, and I'm a fan of solar, Germany is not the best place. And if they don't spend the 12 billion, they won't be able to do it. Renewables are a wonderful thing. They ought to be part of the mix. They don't operate all the time. We need electricity all of the time. And that's one of the things that gets lost in the debate. There's no way you should ever operate a nuclear plant unsafe or it should be allowed to continue operating, but keep in mind how unsafe it is for society if you don't have electricity. There's two billion people with no electricity in the world, okay? And they are not living the lifestyle we live in California, New York or even South Carolina. So we need to keep in mind, why you have nuclear plants, renewables and everything else, it's to provide electricity.

**Greg Dalton:** Marv Fertel is CEO of the Nuclear Energy Institute. We're talking about nuclear power in America. Other guests are Jim Boyd, former commissioner of the California Energy Commission, and Joe Rubin, from the Center for Investigative Journalism. I'm Greg Dalton. Marv Fertel, let's come back to what the United States industry and government are doing to prevent a Fukushima in here.

**Marv Fertel:** That's really good. There's a lot of good lessons learned coming out of Fukushima, but there's three really big important things that have come out of Fukushima and -- I'm not dismissing the other things. But the three big things goes first to what Jim talked about, get the design basis right, make sure you designed for the appropriate hazards.

And make sure your plant layout reflects that design basis. So if you've got a tsunami or a flood condition, don't put your diesels and your other switch yard -- switch gear in the basement in not water-tight rooms so that you going to lose them. So to get it right, make sure you do the layout right. The second one is, even if you get all of that right, you have to be prepared for something that could happen that could take away all of your power, all of your AC power because that's what you use to get water into the core and water in to where used fuel is, so make sure you get that. And then the third thing is make sure you've considered how many units are at the site. The industry and the NRC -- the NRC has actually imposed three new orders and two demands for information that have everything from walkdowns on seismic and flooding to what you're going to do for the loss of AC power. We think, and I think they believe too, that the smartest thing we can do to deal with the AC power is to actually have a flexible concept, where what we have is portable equipment, lots of it on site. Alternative ways of looking it up to get water into the vessel and water into the pool, and then we have offsite capabilities to come and enhance that over time for the long term.

**Greg Dalton:** You're talking diesel generators on trucks to bring power in--

**Marv Fertel:** Yes.

**Greg Dalton:** --something like that.

**Marv Fertel:** I mean we have loads of diesels on sites right now. What we're looking at is mobile equipment on site, diesel driven pumps, hookups into contain -- into the vessel and other places that

we know we can get to, but that if we couldn't get in a one way, we can come in another way. We learned this after 9/11, okay? After 9/11, one of the concerns at the plants that the NRC had and the industry had was what if a plane hits a plant? And what we learned was different from the way you normally think about nuclear where you make everything pretty rigid. I'm going to hook it up here, I'm going to get the water from there, well you didn't know where the plane would hit the plant, you didn't know where the jet fuel would go. And what you had to do was be flexible. So we basically did that from the standpoint of dealing with aircraft, but we didn't do it as robustly looking at other hazards nor did we do it by at looking at multiple units.

So we actually are taking a lesson learned from 9/11 and to be honest expanding it dramatically. And to us that gives us the greatest immediate benefit from a safety standpoint, plus a bunch of other things that NRC wants us to do.

**Greg Dalton:** And how much is this -- this is already happened today versus what we're going to do at some time where we can around to it.

**Marv Fertel:** Well this is happening today. There's been about five or six hundred pieces of equipment already ordered. We and the industry committed by the end of March to have ordered all the equipment they think they'll need for what we're calling a flex approach. Our goal is to have it installed by the end of the year, have it on site. And then we're looking at these regional centers to bring more equipment into the site. And again, I don't want to downplay the other stuff that the NRC has us doing, as far as walkdowns for seismic and flooding and things that may come out of that. And also to Jim's point, the NRC is asking everybody to do a reevaluation of their seismic and flooding design basis right now as part of this. I would actually Jim, not propose it be part of license renewal personally. I think what we need is a process that we don't have, the NRC doesn't have.

When you get new information on any hazard, a flooding hazard or a seismic hazard or a new chemical plant gets built next to my nuclear plant and I have to worry about the chemical plant having an accident and it affecting the nuclear plant. How do I deal with that new information?

How do I determine the significance? How do I deal with it over what time and stuff like that?

That's a process that we actually think is the right process. You don't wait 10 years, you don't wait for license renewal, you need to do it in real time when the information becomes available.

**Greg Dalton:** Jim Boyd, California has a plant - that there are some seismic questions about some new faults that were discovered and is not been up for renewal yet, but the utility that operates that once tried to push that forward.

So where -- should nuclear seismic issues be considered in relicensing?

**Jim Boyd:** Well I certainly would agree with Marv with regard to seismic should be considered all the time. But since nothing was happening there, our recourse was to say you can't go another 10 or 20 years without looking at that subject. Right now, Diablo Canyon, which more and more faults were found offshore, is going -- finally through a process of getting permission to do the seismic studies. PG&E, the operator of Diablo Canyon filed more than 14 years ahead of the ex -- the --

**Greg Dalton:** Expiration date.

**Jim Boyd:** Expiration date of their license, which we thought was a rush to judgment and frankly, you know, we got -- you know, we're not anti-nuclear we're just a little concerned about the behavior of some people. So you got to remember I'm a -- I use analogies of three-legged stools all the time, and it fits this one, you've got technology, you got human beings, and you have Mother Nature. And it's all a system. And technology gets old, we've been waiting for years for the new technologies, things wear down and weather. You've got human beings, who designed, built, operate these

facilities, we make mistakes as humans and then Mother Nature has been totally unpredictable throughout my entire lifetime in terms of potential. When you put those three things together in a system, you'd better be darn sure you've covered every single base. And I think this discussion shows that we've not been too good worldwide as recognizing the risks. And as I said before, big payoffs, but incredible risks. And if you're going to use nuclear, you had better make it as so foolproof that you make the decision to proceed with it. Two other things, health -- the nation has not solved the waste problem to this day. And when the nation embarked on nuclear power, the promise of the federal government was we've come up with a facility or facilities to house the nuclear waste, that doesn't exist to this day.

We're still keeping it onsite at the plants. Some of us are uncomfortable with that. And other thing is cost. I mean the cost of these plants is horrendous and so you have to do a cost amortization, does that really give you cheap power, does it really provide the environmental protection that you need? And that all has to be analyzed all at once, and we need a better system.

**Greg Dalton:** Marv Fertel, John Rowe is a retired CEO of Exelon, which is a Chicago-based utility that serves customers in Pennsylvania and Illinois, and is the largest operator of nuclear power plants in the country. I'd like to read you a quote recently from John Rowe, "Let me state unequivocally that I've never met a nuclear plant I didn't like. Having said that, let me also state unequivocally, that new ones don't make any sense now. I'm the nuclear guy, and you won't get better results with nuclear, it just isn't economic, and it's not economic within a foreseeable timeframe." Is John Rowe wrong?

**Marv Fertel:** John Rowe is right for a merchant plant in a merchant market. John Rowe is not right for the fact that we're building four plants in the Southeast right now, two in South Carolina, two in Georgia, it's a regulated market. Their public utility commission, their state legislators and their governors have decided that natural gas is very cheap now, and that's what John's referring to. But they don't want to be locked in to natural gas for the next 60 years not knowing where the price will go. So they want a diversified portfolio, they are fortunately not a merchant market--

**Greg Dalton:** Merchant market meaning -- explain what that means.

**Marv Fertel:** The difference between a merchant market and about half our country has merchant markets right now, I'm basically bidding my electricity into the market, I'm competing with other sources. If I'm in a regulated market, I have a public service commission, they set a rate for what you as a residential customer, an industrial customer, a commercial customer would pay.

It has very little to do with what the price of electricity from that plant is. So they can actually take a long-term view, a nuclear plant is a 60-year asset. They can look at it and they can say I have very good stability over 60 years, I want to have diversified portfolio, I might have a carbon standard--

**Joe Rubin:** It was -- it was originally only supposed to be a 40-year--

**Marv Fertel:** That's true, but that's--

**Joe Rubin:** --that shows where we are in the United States now it's that--

**Marv Fertel:** Let's talk about that--

**Joe Rubin:** --but that game is changing.

**Marv Fertel:** Let's talk about that, Joe. Forty years is what's in the Atomic Energy Act, okay? I have, for 20 years, been trying to find out where the 40 years came from. And the best two answers

that I've heard is that's what they used to amortize investments over, and the second best answer was that's what the Federal Communication Commission use for licenses, okay? Nothing at a nuclear plant is designed to stop working in 40 years, okay? As I said earlier, all the moving parts are in a maintenance program -- predictive, preventive or corrective. The non-moving parts, the reactor safety systems and other stuff that you look at, you analyze based upon a 40-year life, because that's how long your license is and the NRC says you got so much margin. But nothing is designed to fail. Now I'm going to leave here in a little while and get on a 40-year-old airplane and I certainly hope it's got the same maintenance program I know we have, and we all do that.

**Greg Dalton:** So okay, so the 40 or 60 years, Jim Boyd?

**Jim Boyd:** Well, I was just going to say I'm going to go back to the interaction of all these components, the Mother Nature, human beings, and the technology. The San Onofre plant which we called SONGS, it is now having a materials -- a significant materials problem brought on by design or materials failures in the two-year-old steam generator--

**Greg Dalton:** Is this that nuclear power plant near San Diego, California?

**Jim Boyd:** Near San Diego. And yet prior to that, the plant seemed to be pretty good. But I am aware because of my responsibilities that for years, we had safety culture problems in that plant. So the strongest letter I ever wrote was to Edison about the safety culture in that plant. We found people dry labbing data we found things not being done, we found stupid things happening. And that complacency sets in, and you've got -- I agree with Marv, you've got to do it right, you've got to do it right constantly and we have to have regulatory checks and balances to make sure people do it right constantly, and right now the system doesn't provide for that. And everybody guesses at what Mother Nature might provide and probably undersized everything, and now we have worries about earthquakes, offshore tsunamis, and what have you. So it has to be done right. And some of the old plants are on the coast, do need to worry about seismic concerns that weren't even considered when originally built.

**Greg Dalton:** Joe Rubin.

**Joe Rubin:** Yeah, I mean I think, you know, things go wrong. I mean, the Union of Concerned Scientists just came out with the report and there were 15 near misses just this year. I'm not counting the one more--

**Greg Dalton:** Near misses of what?

**Joe Rubin:** Near misses, the accidents which -- things which went wrong at nuclear plants. That they, you know, that they feel could have, you know, been worse if under different circumstances, if there was a number of factors which happened at the same time. I just wanted to point out a couple of things. One is, I just want to get across, because I don't think it's coming across on the stage of what a dramatic story is going on in this country in terms of a real battle over -- really kind of challenging the whole notion of federal preemption, when it comes to nuclear plants. If you look at New York State, the Indian Point there, and you know -- first originally, you know, Robert Kennedy Jr., who I know has been on this stage, has been a longtime critic of Indian Point and really led a big environmental movement against it.

But I mean the governor of New York, Andrew Cuomo, is fighting a pitched battle there that his Attorney General Eric Schneiderman is filing successful lawsuits about fire safety, about -- and also forcing -- as part of the renewal process that the plant has to undertake millions of dollars of improvements. Vermont, the governor, the state legislature, very upset about their plant there which



was recently renewed because of leaking tritium and a collapsing cooling tower. Massachusetts, Governor Deval Patrick there completely against Yankee Pilgrim, which was also renewed against the objections of Commissioner Jaczko a couple of weeks ago. And so I think that -- this is worth pointing out because this is where we're heading in California. These are states where they are facing their 20-year renewal, you know, now or just recently faced it, and I think that, you know, this is going to become a major issue in this state. The only thing I -- I just wanted to I do more -- can I talk a little about my experience and our experience looking at seismic safety or -- you want to come back to that. Yeah.

**Greg Dalton:** Well, let's talk about California, the issue in California, what they mean for the rest of the country. One with some operating problems right now, it's not clear whether San Onofre will come back online -- will it come back online at a lower capacity. The city of Irvine recently said, nearby said, they want that to be not renewed and to be wound down. So, you know, is that possibly going to happen here at San Onofre near San Diego, Jim Boyd?

**Jim Boyd:** Well that's a good question, and maybe economics makes the decision. Nobody knows exactly what's wrong and the cost of repairing what's wrong may be rather significant, or if it's repairable, it'll never operate probably at the level it was predicted to operate.

Will it operate at enough of a level to generate revenue to pay off the cost? And then last but not the least and most important of course is, well, we better take a harder look at the safety issues associated with all plants and everything associated with them. That steam generator was supposed to last 40 years. It had to be replaced and they said they could replace it and pay it off even within the current licensing, it wasn't a foot in the door to get relicensing as some people alleged. That remains to be seen. We've concentrated on Diablo Canyon for seismic activity because more and more faults are found where we also asked for the same studies to be done offshore San Onofre, it was the oil industry doing explorations using technology years ago that discovered the fault offshore Diablo Canyon. It was multiple agencies including the Feds and PG&E who found the second fault here a few years ago. But the federal agency and PG&E are arguing over whether it's a significant find or not. The federal scientists feel like it is connected, it could be significant, look at Fukushima. Therefore, everybody should be assured that we're relatively safe before a decision is made to continue operation of facilities and that they can be operated safely so we don't have a Fukushima or we don't have a major disaster. Because as I've said before, the risk is incredible. You can blow up a gas plant -- sorry to say that, or a coal plant and you can have some disasters. If you mess up a nuclear plant, well just look at Chernobyl and Fukushima, so risks, rewards.

**Greg Dalton:** Jim Boyd is former commissioner of California Energy Commission. Marv Fertel, thoughts on -- could San Onofre be taken offline? It could be uneconomic to continue operating that plant?

**Marv Fertel:** I can't answer that Greg without more -- a lot more information. But what I can say about San Onofre is -- Jim pointed to safety culture problems which were very visible within the NRC. The -- it was clear they were all over them.

But the thing I can tell you is I saw the Ted Craver statement recently as the CEO and he basically was very clear that he's going to make sure it's safe before he starts up or it won't start up. So I think that from a safety culture standpoint, that's what the people of California should feel good about is that there's a change in safety culture across that site led by the CEO. The other--

**Greg Dalton:** Well, I guess it'd hard for a CEO to say, hey it's not safe but we'll start it up. I mean--

**Marv Fertel:** Well, he'd never say that. But he didn't imply at all that it wouldn't start up. He said

it may not; it'd be a really tough decision. So you know, take the man at his word for doing the right thing. The second thing is, in Fukushima, I will not at all downplay the significance of Fukushima as an accident. But let me just put something in perspective. There's almost 20,000 people dead in Japan from the earthquake and the tsunami, there was no one dead, there was no one injured, and there's no one having health effects from the studies that they've done so far, and that doesn't mean there won't be down the road from Fukushima. Now, some of that is fortunate that the wind was blowing offshore most of the time, but what we saw here on TV the whole time was we saw a terrible accident at that nuclear plant, we saw trailers talking about 15,000 missing, 12,000 dead, that was the tsunami and the earthquake. The stuff washing up in Oregon, the stuff washing up in Alaska, is not Fukushima. It's from the millions of tons of material -- houses, boats, bodies probably, that were washed ashore, washed out to shore from that terrible tsunami that they had. Also, the actual Fukushima plant had no problem with the earthquake. It shut down safely from the earthquake.

What killed Fukushima was the tsunami, okay? We had an earthquake in Virginia last year; it was bigger than the design basis than the North Anna plant.

It was 11 miles from the plant. There was nothing from a safety standpoint that was even dented or hurt or whatever from that. And that plant was reviewed by the NRC and by the agency; there was no damage to any part of that plant from a safety standpoint.

**Greg Dalton:** Jim Boyd.

**Jim Boyd:** I just want to make the point that there's another nuclear plant in Japan, the world's largest nuclear plant, that suffered significant damage from an earthquake several years ago. And Japan is, you know, they know they're on earthquake zone, they have designed basis to allegedly handle those situations, and yet this plant suffered fairly significant damage, some of the units were not restarted, from man's inability to get it right--

**Marv Fertel:** Just on that Jim, but -- and Jim is right. That's the Kashiwazaki plant, there are seven units there, it suffered some damage. There was water that slushed out of the pool. There was tremendous damage to the villages and everything else around there. All the safety systems worked fine, the plant shut down safely and maintained safe shutdown. Yes, there was a lot of damage to the plant, but not from a safety standard--

**Joe Rubin:** But I really don't--

**Greg Dalton:** Joe Rubin?

**Joe Rubin:** I don't think this is the point. I mean I think the point is, is that there was, you know -- how often we have core meltdowns and we've now had two of them and they're all different, and they're all different scenarios. And so it's really sobering and they're happening much quicker than there's -- there are, you know, the science or the NRC or people on the field say that should be happening. So it's a big concern. I just wanted to talk about what we found in our research in terms of seismic safety and -- here in California, because I feel like it speaks to the whole culture issue. And this is something which is kind of haunted me.

So basically the story with the Diablo Canyon is there's two fault lines primarily in play there.

There's the Hosgri fault, which we've known about for some time and that's about four miles offshore, and then there is the shoreline fault, which is basically half of a kilometer from the reactors itself. And so this was discovered by USGS scientists in 2008. And what I find troubling about that is -- and Jim, I'd love to know if you agree with this or not, is I do not think that -- and I don't know, I'm pretty certain about this, if Fukushima hadn't happened, we wouldn't be having any studies

whatsoever that -- around that plant. Because I was there, I could feel in the state house in the capital here in Sacramento, that changing. And I was there the days after following Fukushima. And I heard PG&E's testimony; I heard the NRC's testimony. And they were saying the plant is safe, it's seismically safe, and we also -- the NRC is saying we trust the -- what PG&E's seismic safety staff is telling us. I am holding it here in my hand a -- this is what kind of haunts me, I'm holding in my hand here a graph, and this was basically in the period before Fukushima when PG&E was dealing with the aftermath of what the significance of this fault line is. And this is what we discovered in the course of our investigation, and at one presentation, Norm Abrahamson, who is an employee of PG&E and a Cal Berkeley professor, he presented basically -- okay, we don't think that this fault line, this is what he said, connects with the Hosgri fault, that's -- we don't believe that. But what if it did connect? And he basically, in his presentation, he tried to downplay the significance of that but he showed a slide, and this slide--

**Greg Dalton:** It's a hard to thing to see [crosstalk].

**Joe Rubin:** Yeah, I will--

**Marv Fertel:** It's not that--

**Joe Rubin:** The point is--

**Greg Dalton:** The risk is greater than the company's acknowledging the effects?

**Joe Rubin:** The point is, is that it was the level of shaking was above the level which could potentially cause core damage at the plant. You can clearly see it. Now he downplayed that, he said it wasn't that much above it, it was, you know, at a frequency which wasn't that important.

**Greg Dalton:** So the risk could be significant at that plant for seismic risk? Let's move on.

**Joe Rubin:** Yeah, and then the point is that also that the NRC, when we spoke to them, I mean -- we went -- I went to Texas and we talked to the head of Region 4, and he told us basically you know, yes we fundamentally rely on what the utilities are telling us when it comes to seismic safety. So now, since then, there's been some political pushback and we are seeing these studies go forward. But I feel like culturally I find it troubling, and I find it troubling that, you know, there's the potential that at this very moment that that plant could be at seismic risk.

**Greg Dalton:** Jim Boyd.

**Jim Boyd:** Well I can't answer the question about would we have the studies had there not been a Fukushima. Certainly Commissioner Byron, the former commissioner, is also sitting in the audience and he and I did one of the integrated energy policy reports that -- a couple of them, that the energy commission does. And repeatedly this agency has pointed out these issues. They don't get a lot of traction with our legislature, unfortunately, or a lot of traction because there hasn't been a calamity that -- until there was a calamity, except for Legislator Blakeslee -- Sam Blakeslee, assemblyman, senator, PhD, seismologist, et cetera, et cetera -- drove this issue like crazy in the California Legislature and against our other energy agencies in California. I don't know if there would have been the studies. Thank goodness there are these studies. But California would have been pushing it and it's hard to say if it would have been done. I think that's all I -- I'm not anti-nuclear, I am for what is good for my, you know, my native state being a fourth generation Californian, and a 50-year, just-retired, public servant in California.

What -- you know and a technological wonk, I mean I'm waiting for the technology they've been promising all my adult life and I'm waiting to see that we as humans do it right. And only when you

can do that do I feel comfortable with the situation. So hopefully, my agency will continue to prod and the agencies that make decisions, or our regulators, will get in there and do what they have to do.

**Greg Dalton:** We're discussing nuclear power in America with Jim Boyd, former commissioner of the California Energy Commission, Marv Fertel, CEO of the Nuclear Energy Institute, and Joe Rubin, a reporter for the Center for Investigative Journalism. I'm Greg Dalton. I want to pick up on something Marv Fertel said which was the sort of the casualties from Fukushima, and ask Joe Rubin and Jim Boyd, more people die because of coal than nuclear. If you consider the particulates, the pollution, the disease, coal is much more dangerous. More people died in mines -- coal mines than a nuclear power plants. Isn't coal much more dangerous environmentally than nuclear, Jim?

**Jim Boyd:** That's a very interesting question. And you're going to get into a debate about whether Chernobyl really -- whether the data has ever been totally proven. How many people were affected by, and will ultimately die because of their exposure. We won't know for years what happened in Fukushima and how people will be affected. We certainly know how their economy has been affected, and whether or not they will make a vast wasteland out of the piece of real estate. I certainly don't agree that there's danger in every type of activity that we're engaged in and you need safe coal mining and so on and so forth. And I'm certainly not pro coal, unless coal could be made as safe as and as clean as, health-wise, as natural gas or something else. That we had said was, that's what we want in California, something that burns at least as clean as a natural gas combined cycle power plant, then we'll even think about it. But remember, efficiency is job one in California, that's the best thing to do.

Renewables is job two. And then only clean generation is the third tier. So it's not a debate of the safety and health aspects of coal versus natural gases versus nuclear, and we don't know enough about nuclear and what about the people who mine uranium and how they've been affected and processed uranium. And look at what we did to all those soldiers during the years that we tested above ground and exposed them. And, you know, look at the years and years and years of knowledge accrued after the atomic explosions in Japan, about what happens to, you know, the human species when it's subjected to this type of radiation. Do you want to take that gamble? Do you want to take that risk until you're assured pretty much a 100% that it isn't going to happen?

**Greg Dalton:** Joe Rubin, quickly, we're going to move to our audience questions. Coal is more dangerous than nuclear.

**Joe Rubin:** Now well, I mean, first of all nuclear is an impressive technology. I mean 16% of our energy in California comes from it and putting aside the nuclear waste issues, I mean it's -- it doesn't create air pollution. It's clean carbon. I mean there is a lot to be admired about nuclear power. And I'm not anti nuclear either. I think what's -- what I'm about and what journalism is about is making sure the public is informed so they can make good decisions. But I think -- one thing I've actually been looking into is that we have this incredible example here in California, because we're going to have this debate over the next decade, and that debate is should we -- should these two plants be -- should their license be renewed or should we go another course? And we have an incredible example, which is Rancho Seco in Sacramento which voters shut down because it's a publicly owned utility, shut down in 1989. And I think that SMUD, which is the utility there, Sacramento Metropolitan Utility District is -- pretty much everyone would like to be a SMUD customer, because their rates are 20% lower than PG&E.

And there are some other impressive things about SMUD. And this is -- I spoke to people there and they feel that this is because precisely they were able to get off this really troubled plant. They have -- they exceeded their level of renewables, 23% in 2010, and they feel that they're on track to have

38% renewables by 2020 for the AB 32 goals they have, an incredibly impressive array of biomass and solar and wind power. So I think that in terms of your question, I mean I think the issue isn't how many people die from coal or how many people die from nuclear. It's what's smart, what makes economic sense? What are the real safety issues that are involved, not you know, is coal, you know, more dangerous than nuclear.

**Greg Dalton:** And on the economics, let's do this final point before the audience questions. On the economics, Marv Fertel. Dan Yergin is one of the most respected energy experts in the world, and he told Fortune Magazine recently that natural gas will be the default fuel for new electrical generation going forward. The fact is, it used to be Greenpeace was against nuclear, now it's green backs that are the problem, that the cost of natural gas is so cheap that it's just making nuclear a hard sell.

**Marv Fertel:** Well it's making anything, but gas a hard sell. But now you have, you know, Friends of the Earth and Sierra Club against gas. So we'll see what happens, Greg. There's no question we're going to build a lot of gas in our country for a while. There's also no question that two and a half dollar gas won't stay two and a half dollar gas.

**Greg Dalton:** Natural gas, we're talking - yeah, but--.

**Marv Fertel:** Right, natural gas.

**Greg Dalton:** Right. So that price will go up. Let's go to audience questions. Yes, sir. Welcome to Climate One.

**Craig Bramer:** Thank you. My name is Craig Bramer, and I've been pro nuclear all my life actually. I like the technology. But since Fukushima, I've been paying attention about what happened to Arnie Gundersen at Fairewinds. And he's been the only person, in my awareness, who's actually tried to explain what actually happened. And he's really been critical of Mark I boiling water reactors and basically maintains they should be shut down.

But since we're talking California, I'd like to bring in to the forum, Santa Susana. And there that was Ventura County back in the late '50s. I remember an early memory of mine on TV watching one of the newscasters flip a switch, turned on the lights to more -- the city of Moorpark in Ventura County, the first -- they have about five or six reactors going there in the Santa Susana Mountains between Simi Valley and Moorpark. Three of those reactors had meltdown, and almost nobody talks about it. It's just one of those things that was ignored back in 1959 because nobody particularly cared. But if we're talking nuclear energy in California, Santa Susana needs to be brought to the floor because that's where we've had significant nuclear damage, threatened all of Los Angeles, Southern California and nobody knew. One local hospital turned their -- had a floor dedicated to cancer from the Santa Susana employees.

**Greg Dalton:** Thank you. That's -- goes back, so not with no comment on who remembers that time or the years, is it? Jim or Marv?

**Marv Fertel:** I've -- I have no knowledge of it.

**Jim Boyd:** I'm aware of it, appreciate it that this young man bringing it up. It is not something that's been on the dialogue on a regular basis. They were small but there was a dilemma, and yeah, you could extrapolate that up, it was a long time ago. Hopefully we're a lot better at doing things. But some people paid an ultimate price for that, and they're still cleaning it up. And it's still off limits to an awful lot of people. And the Humboldt plant was closed down many years ago because it

got old and it was already a generation, but closed down in the nick of time when earthquake projections began to show, that would be a tough sell. So -- I mean the gen 1 and gen 2 stuff -- gen 1 stuff is really old and it probably should be closed down. Gen 2, we're dealing with right now in our dialogues over in California and promises of what gen 3 and gen 3-plus might bring us, hopefully we -- you know, we humans learn a lot and maybe we can do things right.

**Greg Dalton:** So for our next audience question. Welcome.

**Gar Smith:** Thank you, my name is Gar Smith. I'd like to point out that it's not technically correct that nuclear reactors produce electricity, they produce heat, the heat is used to produce the electricity--

**Jim Boyd:** That's true.

**Gar Smith:** -- is sent through the generator.

**Greg Dalton:** Boiling water, okay.

**Gar Smith:** Right. Many ways to produce heat, some people call it the most expensive way to boil water. There's one other thing that nuclear reactors produce that is seldom mentioned, it was not mentioned at this discussion, it's the nuclear waste. It's the major product that these plants produce and that poses a major problem. Also, it's not the case that nuclear reactors are always on 24/7. Nuclear reactors after a couple of years have to be shut down to replace a third of their core fuel. And those shutdowns can last for at least a month if you're lucky, and if there's an unplanned shut down, those plants could be offline for -- well as we've seen in Japan and elsewhere, for months, if not years.

**Greg Dalton:** Thanks. So that's point taken on the waste. We skated over the waste, we didn't give it justice. It hasn't been solved; the federal government is not fulfilling its obligations to build a centralized repository. Marv Fertel, is the waste problem getting in the way of more nuclear?

**Marv Fertel:** Well I mean, first thing, I'd to like I mentioned on the waste problem is to compliment your senior senator, Senator Feinstein, for her leadership in the Senate right now. She has gotten legislation in an appropriations bill that will definitely be in the appropriations process at the end of the year to begin the process to move waste out of Humboldt, certainly from all the shutdown sites quickly, and to create a consolidated storage site. To your bottom line question, we generate about 2,000 metric tons of waste from 100,000 megawatts or so that we have.

It's very toxic stuff that you got to handle really well. It's not a lot of material to take care of. If it wasn't for the opposition of a senior senator from Nevada, we might actually be moving forward on licensing or seeing if we could license a repository in Nevada, which I think most people believe probably could get licensed. So we'll see. I have confidence to be honest that the Senate led by Senator Feinstein right now, will take action get a program in place based upon on this Blue Ribbon Commission report that the President commissioned and that came out in January of this year.

**Jim Boyd:** Quick comment. I'm somewhat of a political scientist and a policy wonk, and maybe the problem with Yucca Mountain is that it was more of a political decision than a scientific decision.

Put in that remote in the middle of nowhere place where there's a nuclear test facility anyway without paying attention to all the answers to all the questions, and then Nevada grew up and got powerful and they start -- they're going to start all over again I think in terms of finding a site.

**Greg Dalton:** Let's have our next audience question. Welcome.

**Bob Gould:** Hi, my name is Bob Gould. I'm a pathologist. I'm also president of the San Francisco Bay Area Chapter Physicians for Social Responsibility. And I'd like to just raise a few questions, and anybody -- you could--

**Greg Dalton:** Yeah, they're at the other line, yes.

**Bob Gould:** Just a number of points that people to address. One thing that was said was I think really minimizing what the greenhouse contributions of nuclear plants are because although when operating, they're not producing the carbon dioxide, there's a great deal of fossil fuels used in the construction of such plants and we have to take a life cycle approach towards health including uranium mining, et cetera. We also have to consider for the future what the impacts of climate change are going to be, and what we're already seeing in terms of the flooding that took place in the Missouri River, the vulnerabilities of for example the Calhoun reactor to back up systems and the like.

And I also think that we also need to be able to talk about the fact that we don't have the public health infrastructure in our country to deal with disasters of the sort that we've seen in Fukushima. Hundreds of thousands of people live within 50 miles of nuclear power plants that our own country suggested would be the appropriate evacuation zone for our own citizens and soldiers in Japan. There have been a number of reports dealing since 9/11 about the deficiencies of laboratories to be able to diagnose nuclear injury, that the basic facilities and personnel being able to address these issues. So I think we have to be very clear about what the public health implications are, we also have to think about the proliferation issues that are dealing with--

**Greg Dalton:** All right. We got three there, thank you.

**Bob Gould:** Okay.

**Greg Dalton:** So we're not ready for a nuclear disaster, Marv Fertel.

**Marv Fertel:** Well, I think -- first of all I think we're doing everything to make sure commercially we don't have a nuclear disaster. I think post 9/11 it was an awful lot of dirty bomb discussions, as well as learning about nuclear plants. So I would say that yes, we're ready and we're going to be even better because we're taking lessons learned, not just from Fukushima but the entire -- this is the place where the Nuclear Regulatory Commission was ahead of the Fukushima accident. They have revised their emergency planning rule before it, which required a whole bunch of new things. So I think we will be ready. But those are real issues that you have to address in a meaningful way.

**Greg Dalton:** And life cycle analysis, Jim Boyd, you know, people often talk about degeneration. There's fossil fuel inputs into nuclear power plants, is that significant in a greenhouse gas perspective?

**Jim Boyd:** It is significant. And I -- Professor Jacobson of Stanford has raised this in some of his analysis of -- the cradle-to-grave analysis that should be done. I mean, we're into these life cycle analysis business; we should do it to everything so you can make a fair comparison. I think nuclear comes out still the cleanest in terms of climate change, but then weigh it with the risk.

But nonetheless, you got to do all of that and there are consequences and there may be public health consequences as I said before that we don't even know the final outcome of.

**Greg Dalton:** Let's have our next audience question. Welcome.

**Patricia Port:** Yes, thank you, Patricia Port. I think we need to bear in mind that so many of the

earthquakes reported from all over the world by the US Geological Survey are on previously unknown faults.

**Greg Dalton:** Jim Boyd, it does seem that new faults appear and we -- and Marv Fertel, faults have -- you know, the one in Maryland, right? That was--

**Jim Boyd:** Touché. I mean, you know, I grew up in the Central Valley, which I was as a child told that were earthquake-proof, you know, it's just a big soft spongy pile of dirt. And -- well now I think we've discovered the whole mantle of the earth is made up of cracks and crust across this side and the other end. And it's something to be concerned about. But the ability of scientists to understand it better has also improved dramatically. And so you're going to go through this process of weighing the knowledge. You know, the key thing is to do -- use all the technology you've got at the moment you have it. Don't drag it out over time as some people I think are guilty of doing in order to rush the judgment and not get all the answers you could get and make the decision.

**Greg Dalton:** Marv Fertel, should the Nuclear Regulatory Commission pay more attention to earthquakes? Make it part of plant renewal?

**Marv Fertel:** Again, when they are paying a lot more attention to it, they -- to be honest they were paying attention, but probably not on the paths or the speed that Jim would have liked to see. They are paying more attention. I would not care whether it's part of renewal, like I said we ought to learn to deal with new information in real time, not make it part of renewal or a 10-year cycle. Do it when you get it and figure out if it's significant and then figure out how to handle it.

**Greg Dalton:** But should a plant like San Onofre or like Diablo Canyon be relicensed with great uncertainty about the seismic risks for that plant?

**Marv Fertel:** I think that they'll resolve the seismic risks based upon the 3D studies they're trying to do now and the analysis that they'll do, and I think that they'll go ahead and look and see whether or not -- it doesn't matter if it's relicensed, Greg, because you could have that come up the day after it's relicensed and you'd want them to look at it and not care that they just had another 20-year license.

**Greg Dalton:** Joe Rubin.

**Joe Rubin:** I agree there has been you know tremendous advancements in seismology and that we are getting better at understanding. But I don't think that there'll ever be a -- there'll always be a great deal of uncertainty around places like San Onofre, and particularly around Diablo Canyon. And so I think it becomes just a question of human judgment and political judgment as to whether or not we might want to say, okay, well this plan has been in existence for 40 years. We probably wouldn't have built it if we knew it was right underneath a large earthquake fault. Perhaps it's good to retire it or not. I mean -- or we're willing to live with those risks, I think. But I think there has to be a pretty, you know, serious debate as to whether it should go forward.

**Greg Dalton:** Joe Rubin is a reporter with the Center for Investigative Journalism. Our other guests at Climate One today are Marv Fertel, CEO of the Nuclear Energy Institute, and Jim Boyd, the former commissioner of the California Energy Commission. Let's have our next audience question. Welcome.

**John Hurstep:** John Hurstep, I'm at UC Berkeley. I am encouraged that at least one person mentioned real concern about the waste issue and the way it's stored. Because it is potentially a hazard above and beyond everything else we've been talking about. But what troubles me about the



entire discussion is they were kind of embedded in the economics of electricity generation. And I think in the design for nuclear plants to resettle on a long, long time ago is the universal design for all of the nuclear plants that are made in the US.

There have been advances that have been promoted in France and -- I've heard people come to the Commonwealth Club and talk about the plutonium reactors and ways maybe to generate nuclear energy in the absence of the use of water. So there are things going on and there's very little in the discussion today that has any of that forward-looking attitude towards it. And I would like--

**Greg Dalton:** Thank you. So new technologies, can -- are we inside the box here? Are there new technologies out there--

**Jim Boyd:** No. John, thanks for the comment. The plants being built in Georgia and South Carolina are the most advanced technologies in the world right now. And basically they've got a lot more passive systems -- if a Fukushima-type accident happened with those plants, if they were there in Japan, the plants would basically be able to go 72 hours with no power, keep the reactor core cool. They could go 30 days in keeping the used fuel cool. So the problem you had in Fukushima, if you had the designs that we're building now in our country, would have probably never digressed to the accident conditions that they saw, because they would have had so much more time to be able to take corrective actions. And it's because the US design now is the most advanced. Now, can they get more advanced? Absolutely.

**Greg Dalton:** Let's also talk about briefly small modular reactors, the idea of a smaller nuclear power plants. Bill Gates is backing a company called TerraPower, which is using depleted uranium, supposedly is going to produce less waste. Quickly, Marv Fertel on those two.

**Marv Fertel:** Small modular reactors right now are something that in our country there's a lot of interest, internationally there's a lot of interest. Because if you have a country without a large grid, you don't want to put very large power plants on it, be it nuclear, coal, or anything else. Yes, Bill Gates is looking at a very advanced reactor; it jumps well beyond where everybody else is looking right now. But he's going to build it in China, because he can't get through the regulatory approvals fast enough here.

I'm not sure that's what I would encourage him to do. I think you're going to see in our country, the Department of Energy has a solicitation out right now to fund -- to jointly fund -- and it won't be real joint, it will be about a third to them and two thirds to the companies -- two new smaller modular reactor designs. And that's out on the street, there's four companies bidding that, and we'll see where it goes, but it might be a real breakthrough not just for our country but actually as a big export market opportunity.

**Greg Dalton:** Let's have our next audience question. Yes, sir.

**Angelo Festa:** Hi, my name is Angelo Festa, I live in San Francisco. And so far -- maybe I missed something, I don't think I dozed. But I -- all of the vulnerabilities that you've mentioned have been natural in nature, you know, tsunamis, fault lines, et cetera. What about us? What about people? If I were a terrorist, I don't think like -- and I wanted to do serious damage as far as the infrastructure is concerned, I wouldn't go attacking windmills.

**Greg Dalton:** No, but Jim Boyd, you've mentioned human vulnerability, let's wrap it -- yeah, there.

**Jim Boyd:** Well, I mean I obviously been deep in the subject ever since 9/11, and while we did really encourage the NRC to look at the design basis threats, design criteria and maybe make them more

rigid in some cases, I think the psychological threat of attacking a nuclear plant is far beyond the real threat of causing harm. I mean it will take lifetimes of terrorists to slice through a dry cask or get in the containment building. The spent fuel pools, that's something we have worried about through the NRC, admittedly they had seemed a little more vulnerable and what have you. I'm more concerned about the dirty bomb. I'm more concerned about the all the nuclear materials running around in our society that has nothing to do with nuclear power or military being aggregated into a dirty device than I am about a nuclear plant.

So if I was a terrorist, I'd blow up the switch area of the nuclear plant, scare the living daylights out of millions of people, and I do not think there would be a radiation threat, that's my assessment from the years I spent on this subject. That's not the reason for not -- for attacking a nuclear power plants, I think, in terms of we want them or we don't want them. There are a few vulnerabilities. They need to spruce up the ability to repulse any kind of attack, you can't take a plane out of the air, but I think we need to harden the spent fuel pools in some cases and I don't think that's the thing to really worry about in spite of all the Hollywood movies that make it a threat.

**Greg Dalton:** Marv Fertel, let's wrap up on the future. Four plants are underway right now, will more get built and those four underway right now in Georgia and South Carolina?

**Marv Fertel:** We've been saying for about three or four years now, so it's pre-Fukushima, that in our country because of the recession, because of shale gas, and the drop-off on electricity demand, we saw four plants -- we were thinking four to eight, but we really saw four, by 2020. We think there'll be more in the pipeline for construction, there's 10 more getting their licenses from the Nuclear Regulatory Commission. But I don't think we'll see a lot more than four operating by 2020. I do think you'll see more in the pipeline for both licensing and construction by 2020. But...

**Greg Dalton:** Joe Rubin, is that good for America to have -- build some new ones and continue to relicense the existing ones?

**Joe Rubin:** I don't know what's -- I can't say what's good for America--

**Greg Dalton:** Yeah, that was like a broad one there.

**Joe Rubin:** --what's not good for America. But I think that it's -- you know, there's a lot of -- I mean the issues around nuclear power still exists. It still needs loan guarantees from the Federal Government. There's no insurance company that will touch a nuclear plant and the liability is limited to \$22 billion, which would come from the nuclear power industry.

So as we saw, you know - in Fukushima I don't know what the eventual cost will be, but some people say half a trillion dollars in terms of damages. So I don't know -- I think, I guess I'll go -- just go back to answering your question, to something I said earlier which I think we're a nation divided. Not surprisingly, we're a pretty polarized society, and I think there are some states which are much friendlier to nuclear power than others. In California, we are prohibited from building any new plants here until the waste issue was solved. So...

**Greg Dalton:** Marv Fertel, you bristled that subsidy issue, the liability shield?

**Marv Fertel:** Well first of all, on loan guarantees, no plant has a loan guarantee yet. Southern Company is still talking about it, they don't have it. It would reduce the cost of the capital which saves their customers money. The risk to the government is about zero. It is not a project financing, it's on the balance sheet of Georgia Power, which has been around for a 100 years and is very solid as a company and these other things. On insurance, basically you have an exemption to have to

have any insurance for nuclear because it's covered by the Price-Anderson Law. So you don't need it, I don't need it, Joe doesn't need it because it's excluded from a requirement because you're covered by what we have to do on the Price-Anderson. So I think we just need to be careful sometimes about looking at certain things, subsidies that really aren't subsidies.

**Greg Dalton:** We have to end it there. Marv Fertel is CEO of the Nuclear Energy Institute and Trade Association for the Nuclear Industry. Jim Boyd, former commissioner of the California Energy Commission. And Joe Rubin, Center for Investigative Journalism reporter. I'm Greg Dalton, thank you all for joining Climate One today.

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