**FULL TRANSCRIPT: First Friday Series with Dr. Edwin Lyman – February 3rd, 2023**

Dr. Peter Andersen: 01:01:01 You got it. Well, uh, welcome. I'm Dr. Peter Anderson with Sierra Club and the Coalition for Nuclear Safety. And, uh, we're excited that you've joined us for this webinar on, on nuclear safety and particularly on nuclear waste and a special focus on Sanofi. We have with us today. A fabulous guest, uh, uh, Edwin Lyman. He is a senior scientist, uh, in the Global Security Program of the Union of Concerned Scientists. He's an expert on nuclear safety and, uh, and nuclear disasters. Uh, I've recently perused his book, uh, on the Fukushima disaster, which has been, of course, a huge global problem. And in a couple minutes, uh, he will be joining us. I'm gonna ask him to make a little opening statement about nuclear safety and nuclear waste in general. Then I'll ask him a few questions. Following that, we'll open it up for general dialogue, uh, questions, uh, from all of you attendees. So, Dr. Lyman, are you with us? Hey, my pleasure. Peter Anderson here. Uh, let's begin today and make sure you're unmuted. Are you unmuted?

Dr. Peter Andersen: 01:02:21: [. . .]it's our pleasure to welcome you and, uh, uh, why don't you just begin with a brief opening statement about the hazards of nuclear power with a particular focus on nuclear waste and maybe even a more particular focus on the issues here on the California coast at Santare Diablo Canyon.

Dr. Peter Andersen: 01:02:46 Go it. For those of you that joined us, the Coalition for Nuclear Safety has invited Dr. Lyman to join us. I'm

Dr. Peter Andersen: 01:03:35 The advantage of Zoom calls is that we can all meet from remote locations. The disadvantage is they inevitably have a technological glitch or too. So hopefully, uh, we'll get this, uh, PowerPoint up and running momentarily.

Dr. Edwin Lyman:

01:04:17 All right. So I was asked today to talk about an issue that I've been, uh, concerned about for quite some time, and that's the potential that dry cast storage of nuclear fuel can be sabotaged. Um, and I've been following this, you know, for actually a few decades, uh, the history of this, and there are some recent developments at the Nuclear Regulatory Commission, which I think people should be aware of. So, um, but I have, I have several slides here. I dunno if you want me to help along, you want me to talk, but, um, go ahead. Yeah. So the, the bottom line is that when a nuclear power plant shuts down, uh, the security requirements that are in place to protect both the reactor and the spent fuel, uh, are greatly reduced. And fact, most of the requirements for security, the most rigorous requirements have to do with protecting the reactor itself or the spin fuel pool against attack, because those are the, uh, highest value targets.

01:05:29 But once the reactor shuts down and all the spin fuels been transferred to the pool, for instance, uh, what's happened at, at songs, the requirements for security for that remaining facility that is the isse or the dry cast storage facility, uh, those requirements are much less, uh, intensive. Uh, in fact, uh, while for an operating reactor, the NRC requires that licensees develop what's called a design basis threat. That is a postulated, uh, uh, adversary with certain characteristics, and they have to have a armed response force to interdict and neutralize that threat. For the isc. The current requirement says, um, uh, that the, um, role of security is really just to assess and

communicate. That is they need to have, uh, be able to detect intrusion, and they need to be able to pick up the phone call local law enforcement. And there's, of course, inherent delay in that. So the question is, is that good enough for the kinds of threats we're talking about?

01:06:42 And, um, the regulations were really based on the idea that it's hard to sabotage a, uh, dry cask. Uh, you don't have, um, e each cask has a much smaller fraction of, of fuel than the reactor core, the spin fuel pool does. And there's no, uh, there's no real driving force, uh, for rele for severe damage to that spin fuel and for release. Um, so historically, the kind of anal, the kind of attack that's been postulated, uh, for attacking dry ca is to use a, a shaped charge, which is an explosive, um, that is designed to penetrate, uh, a thick barrier, for instance, reinforced concrete or, or steel. But the main point of a shaped charge is actually just to penetrate. It's not to actually, uh, do, uh, uh, severely damage the what's inside. Uh, these are anti-tank weapons. And the, uh, uh, once the uh, tank is penetrated, then there's a high probability that the fuel itself will ignite.

01:07:52 But in a spent fuel cask, you don't have that kind of source, uh, for a potential, uh, or under most circumstances, you don't have that kind of source. So the industry and the NRC and, and Department of Energy all believe that if you just use a shaped charge, uh, you're gonna get a little hole and it's going to just damage a little bit of fuel, and only a tiny amount's gonna get out. So you don't have to worry that much about this. But after the nine 11 attacks, the NRC staff started looking at other ways other than, you know, just a, a shaped charge that you could attack a cask. And they found, um, some troubling, uh, resolved. And this is a quote from, uh, NRC document back in, uh, 2007, uh, that points out that the evaluations that they did of certain specific vendors tasks, uh, did find that there were ways that you could do worse.

01:08:55 Uh, you could sabotage, uh, a spent fuel cask in a way that would lead to a larger release than had been previously assumed. And as a result, the NRC staff at that time believed there needed to be new security rules to address these greater threats. Um, and, um, they, although they pointed out that they didn't know fully what the consequences would be of these kinds of attacks, in other words, how much radiation would be released, uh, what type, you know, what would its form be, how far it would go, um, they, um, did believe that there was the potential that it could exceed the radiation dose limits that were, uh, put in place, uh, for these agencies in the event of a security atta, uh, event. And that, uh, regulatory, uh, standard is that if one of these is attacked, someone at the site boundary should not get a dose greater than five rem.

01:09:55 Um, so the NRC death back into and said, we could do so if, what if you have a situation where you could actually exceed the regulatory requirement with one of these advanced terrorist attacks, the NRC said, well, we should have a rule where there's some systematic way of evaluating that risk, and then adding additional features to reduce the threat. As you could add additional barriers, anyone who's driven by, you know, or, uh, San Nore knows that these casks are out in the open air. You're not required to be in a building. There's no, uh, uh, kind of additional physical protection or structural protection, other, the cast themselves. Uh, maybe you need more, or maybe you need to have security officers who are capable of actually preventing access to the casks. Because if, let's say intruders were able to physically access the area where the casts are, um, and they had a method of, uh, effectively sabotaging one cask, well, they could do that to multiple casks in, in a relatively short period of time, depending on their resources.

01:11:01 So maybe you shouldn't let them get near the cast at all. And, uh, another corollary is, well, maybe you should have a boundary, um, which is further away, so that if there were an event, you could tell the public, um, you know, the public would be restricted to, uh, an area further away where the doses would be smaller. Um, and NRC only recently, um, and, and a document pointed out that a potential release from a hypothetical terrorist attack will be immediate. That means, uh, you're not going to have a long delay, uh, between the attack and the, and the release. Uh, but paradoxically, uh, at songs, um, you know, Edison, um, has claimed that it has,

despite what the NRC requirements say that they're doing, uh, their own thing, uh, and even if it's not required. So, uh, it has a vehicle barrier system to prevent, uh, truck bomb from getting too close to the f c.

01:12:05 Uh, it says its security is going to maintain that capability to interdict the neutralized threats, even though the NRC doesn't require it. Um, but also, uh, because of, um, other factors and considerations, it wants to reduce the distance, uh, to the controlled area boundary from, uh, the currently required 100 meters now to 38 meters on the ocean side. That would be, uh, contradicting the staff's recommendation that you may need to actually increase that, that boundary. Um, and in any event, uh, those voluntary measures that Edison has put into place are not inspectable or enforceable by the nrc. So the public doesn't have any real means of, of assessing whether, uh, it's a good enough. Um, and this just an indication of how bad, uh, the doses could be because, um, even a single spent fuel cask might have 10 tons, or let's say 20 <inaudible> assemblies was spent fuel.

01:13:11 This is a, a study that was done by the Department of Energy, uh, and showed that even a single, uh, spin fuel assembly that is one 20th of what might be of large tasks at at songs, uh, if that released, uh, different fractions of radioactivity, these are the doses that you might expect, uh, at the site boundary. And so you see that if you're getting up toward, um, 0.1%, uh, or even 0.01% that these, uh, areas that are accessible to the public, that is the blue arrows, uh, is route the distance away from route five. Uh, so you see that at, uh, 0.01%, uh, release, uh, you could actually challenge that regulatory boundary, which is this, uh, black dotted line, horizontal line. And what if you had enhanced releases of 0.1% or more, you would have pretty high at the controlled area boundary or, um, or, uh, refi.

01:14:16 So these, these are pretty significant results, and you would think that, well, maybe they need to do more, uh, to protect the public from this kind of an attack. Uh, and so, but unfortunately, the N R t, uh, in what they have themselves characterize as a complex rulemaking history, uh, have gone in circles on this issue. Uh, so even though the staff recommended they need to do something, back in 2007, uh, the N R C didn't really do anything except some additional studies. And finally, in 2015 said, well, you know, this isn't urgent, so let's think about it for another five years. But then before that five years was even up, the NRC decided, well, maybe we don't really need to do anything at all. Maybe the measures that we required after September 11th, which are not public and are not part of the rules, were good enough.

01:15:11 Uh, and, um, in 2019, the staff finally said, well, maybe we should just put an end to this. We don't need to do anything more, uh, to protect sites. Uh, but in 2021, the commissioners said, not so fast. Um, we want you to give us recommendations and reconsider the options, including a rulemaking. Uh, so that's, um, unfortunately in November, 2022, the staff came back to the NRC commissioners and said, all right, we've thought about it, uh, but we've decided we still don't need to do anything. We don't need this rule. Um, we looked, we had San Diego National Laboratories do studies of how data would be if these casts were sabotaged with these enhanced methods. Um, but we don't think their results were, we think they're too conservative, and they didn't, they're not realistic. Uh, so that's not the basis for doing anything. They didn't say that.

01:16:06 Um, uh, so they just said that study wasn't the basis for doing something. They didn't say, uh, there's no basis for doing anything, but they conclude in any way. We don't think there's a problem. And that's where things are now. The NRC commissioners now need to vote on this proposal. And I have to say, from my discussions, um, at the nrc, I'm not hopeful that the commissioner is gonna vote to, uh, say we need to go forward with this rule, and therefore it's gonna leave things, uh, in this, um, uncertain state with pot, uh, potentially higher vulnerabilities, uh, with regard to both San no phrase fc, as well as all the other ones around the country at, at decommissioning plans. So, I'll stop there and be happy to, uh, open up the discussion. Thank you.

Dr. Peter Andersen: 01:16:51 Yeah. Let me, uh, let me begin, if I may, with a couple of questions. Uh, the first one is what, you know, the prevailing winds in, uh, in, uh, north County San Diego are west, northwest, southwest. Uh, if there was a major breach of a, of, of one or more casks, uh, how much, how much would wind carry harmful radiation into communities in North San Diego County or South Orange County?

Dr. Edwin Lyman: 01:17:22 Well, again, you know, it really depends on the meteorological conditions. At the time. I did show that graph, um, uh, which is only for one modeling, uh, one weather condition. Uh, and so it really depends on, on the winds and the stability and all the other factors that go into how aerosols are dispersed. Um, but, um, I would say, you know, you could have, um, you know, and again, it, it depends on the magnitude of the release and how credible these different attack options are and how many casts were sabotaged, how much spent fuel was, um, damaged in each one. But it, you know, it is plausible. You would have, uh, detectable contamination as far as, um, many, uh, tens of miles away. Um, and, but, uh, you know, it also depends on how big the particles are. If they're, you know, if they're relatively large, uh, aerosol, uh, they may not disperse that far, they'll fall out closer to the, to the release site.

01:18:30 And a lot of that is not known, that's the problem. It's, uh, very difficult to do the kind of testing that we give answers to some of these questions. For instance, what do those aerosols, uh, look like if you had this kind of an attack? Um, you know, there's very limited data with, well, there's no real, no data with real spent fuel. There's data with stimulants for some of the older types of attacks, even that's a hard type of thing to do. Uh, there was a proposal back maybe, uh, 15 years ago now, uh, to do testing at Sandia National Laboratories with actual spent fuel sabotaging cast that would, uh, these are very dangerous experiments, obviously, and the Department of Energy ended up not funding it. Uh, so, you know, we don't know, uh, really, uh, but, um,

Dr. Peter Andersen: 01:19:23 Yeah, it sounds like, uh, some of the procedures for ensuring the safety of these tasks involve things like direct access or, uh, truck bomb blowing up near it. Uh, but there's concerns about an aerial attack or a missile attack from, uh, the freeway or a missile attack from the Pacific. Uh, could those be highly disruptive and potentially rupture, uh, a number of casts that are sitting there on the beach?

Dr. Edwin Lyman: 01:19:55 Well, in my view, you know, a single explosive charge is not necessarily going to challenge, um, <affirmative>, um, a, uh, a dry cast depending on, you know, the, the particular caste design. Um, uh, it, it takes more, you know, it would take more than a single explosive, uh, because they are thick walled casts. So you do need some way of both penetrating the cast and also, uh, causing some disturbance to the spin fuel that would somehow get it to, uh, you know, potentially even, uh, catch fire.

Dr. Peter Andersen: 01:20:40 Sure. Now,

Dr. Edwin Lyman: 01:20:42 In

Dr. Peter Andersen: 01:20:42 The, in the war in Ukraine, we've seen the use of, uh, bunker buster, uh, missile attacks on it. Uh, are you, uh, what, what's your assessment about the use of such a weapon in the hand of a terrorist, uh, being launched at it that would in fact be able to crack concrete and penetrate the device?

Dr. Edwin Lyman: 01:21:04 Yeah. Well, some of these, you know, sort of advanced adversary attack modes, um, might involve that kind of two stage. So, right. So you need to not only drill a hole, but you need to get some sort of, uh, explosive or some, uh, some way of, um, damaging the contents inside as well, and potentially causing these over pressures. That's all part of the, um, that analysis of these additional attack modes. And then it's a question of how plausible it is, uh, for, let's say, terrorists to obtain those kinds of weapons. Because another important thing to consider is the N R C does not require nuclear facilities to be protected against enemy of the state attacks. Uh, so anything that would be within the capability of a nation, but not in a plausibly within the capability of a

subnational terrorist group, is something that the utilities or the plan owners do not have to worry about. That's supposed to be the responsibility of the, of the federal government, military, and where you draw that line can be tricky because, you know, you also have, uh, terrorist groups that have had state support and might be receiving, you know, both financial and also substantive, um, uh, resources from states. Um, but that kind of thing is a middle ground, uh, which is just not considered Sure, uh, right down. Yeah.

Dr. Peter Andersen: 01:22:32 I'm gonna pose one final question to you and then let's open it up for more general, uh, discussion, if we may. Um, that is, uh, if this were to be moved, uh, off of its present location on the beach at Santa Nore, uh, deeper within Camp Pendleton, or to an alternative site farther away in the state of California, uh, would that enhance the security of this particular site?

Dr. Edwin Lyman: 01:23:02 Well, it would certainly enhance the security of the site, you know, or the, the, if the waste were not there. But, you know, my my own view about the kind of general problem, you know, is that you have, you know, many, uh, spent fuel storage sites around the country Sure. And they all have their own vulnerabilities. Some are closer to populated areas, some are in more protected areas, some are in less protected. Uh, e everyone's in the, in the same boat more or less. And we're not gonna solve the problem just by kind of rearranging the deck chairs and the Titanic. You know, I mean, um, you know, it, the sad thing about this issue and, uh, spent fuel disposal or management disposal is how it does tend to pit, uh, communities, uh, against each other, right? Everyone wants it out of their backyard, but then someone else is gonna get in their backyard.

01:23:55 So you have to, um, but I do think that there are, you know, certain outlier, uh, you know, um, examples where it may make sense to relocate spin fuel, but you do have to worry about the potential for an accident, uh, during that process, not only, you know, uh, uh, moving and, and transporting and, and additionally handling those casts. So, you know, trying to figure all that out is difficult. And, you know, I sympathize with the communities that are stuck with this stuff. Uh, but we do need a national, a solution that doesn't, uh, just heap that risk on, uh, let's say communities that are less well resourced. Sure. And, uh, able to launch opposition to that kind of a project.

Dr. Peter Andersen: 01:24:44 Okay. Dr. Ziegler, uh, Bart, uh, let's open it up for general discussion. Uh,

SLF: 01:24:50 And Dr. Anderson, Dr. Lyman, thank you so much. We do have quite a few questions coming in, please. So I'm gonna start with the first one.

Dr. Peter Andersen: 01:24:58 Go for

SLF: 01:24:58 It. And this one is from Sarah. Does the fact that the canisters at songs and most other plants in the US are thin walled as opposed to thick walled cast used in most other countries, figure it all into the discussions of the vulnerabil vulnerability to sabotage?

Dr. Edwin Lyman: 01:25:20 You know, again, the, the problem is that the vulnerability, you know, it depends on two things. One is the nature of the cas itself, and the other is the nature of the attack. And I would say that, you know, just saying thin walder not as good as thick walled, uh, isn't, you know, you can't make a general statement that that's true because it really does depend on, on the attack mode. It could be that there's little difference with regard to some of the attacks that are possible. And, you know, it's really the seals and the, and the lid. In some cases, it could be the most vulnerable rather than, um, uh, than trying to get through the wall. So I'd say that generally you can't make that kind of inclusion, but I can't say that, you know, it is very specific to various, uh, designs as well as to the attack modes you're considering. And that without having that kind of information, which, um, the n r c rightly, uh, classifies, um, it's very hard to make, uh, that kind of a conclusion.

Dr. Bart Ziegler: 01:26:27 Um, and Dr. And Dr. Levi interrupt for a second, ahead second and say, um, pill loho. We have a, we have a question from Gordon Edwards. Um, he says, would an incendiary penetrated device release radioactive cesium vapors, would this be more dangerous than particulates?

Dr. Edwin Lyman: 01:26:46 Well, c um, metal has this unpleasant property that, um, it has a relatively low, uh, vaporization point. And so when, uh, for instance, in an accident where spent fuel is heated up above, you know, uh, around 600 degrees Celsius, that cesium, uh, if it's a metallic, uh, form, does vaporize and it'll condense rather rapidly, but, you know, condensed to small particles. So that depend, that could lead to why, you know, a type of aerosol that could be dis dispersed more widely. That's certainly an issue in a consideration. Whether, um, you know, that would actually be formed depends again, on, on all these details, which, uh, you know, the analyses are classified, but also the data available to validate those analyses is often not, not, um, available even to the analysts. So it's really hard to say.

Dr. Bart Ziegler: 01:27:50 And, and another question, uh, from Gordon Edwards, uh, is, is, thank you, ed. What's the, what's the maximum eternal temperature in one of the, these, uh, dry casks? I, is there some residual water inside the cask when it is dry sealed, despite the drying procedures? Would this not result in some steam pressure inside?

Dr. Edwin Lyman: 01:28:15 No. Obviously, the, um, you know, the loading requirements are to make sure that it's dry. Um, it, it's hard to imagine that you would get significant steam pressure. I haven't thought about it, but from the amount of residual water you could have, um, that would challenge, uh, the structural integrity of the cask. You know, the, the real, you know, the real issue is whether the, you know, the biggest vulnerability of the caste structures, again, are the seals around, around the lid. And that's really what fails first. If you have, um, uh, things like, you know, accident scenarios like an engulfing fire, uh, is that it's the seals that fail rather than the structure of the cast. Um, uh, so, you know, again, all, all these factors, I, I, I can't get too specific. Um, but again, there are just a number of different factors that have to be considered in this, in this type of analysis. And like I said, it's just the data, um, not, not only is not available to the public, but it's often not available to the analysts.

Dr. Bart Ziegler: 01:29:28 There's, and there's a question here from Roger Johnson. Um, if we move, uh, way beyond intruders and sabotage, please address high explosives and airplane crash, maybe rockets or mortars from 23 parking lot miles away, right? Maybe missiles 1200 pounds warheads launched from cargo ships. Um, what would happen if the canisters were blown up, how much radiation could be spread?

Dr. Edwin Lyman: 01:29:57 Yeah. I do think, you know, my very limited understanding, I do think it would take more than a typical ordinance, single ordinance attack to, to damage spent fuel. There are, there are kind of smarter ways to do it, but they would require physical access. Uh, um, you know, a mortar, you know, explosives have, have a limited ability to penetrate reinforced concrete. Um, that's why shaped charges were designed because they have that property of focusing the explosive in a way to get that, uh, to get it, uh, penetration. But the kind of, um, bulk explosives that, uh, you know, that would be targeted at larger structures. I, I just, I don't think those are the scenarios that I worry about the most.

Dr. Bart Ziegler: 01:31:01 Peter, what do you think? Um, here's another question from, uh, Nancy Vann. What, what do you mean by thick casks? I guess she's talking about thin canisters, which is what we have here at Senate <inaudible> and thick casks, which are what Donna Gilmore talks about all the time, as

Dr. Edwin Lyman: 01:31:21 You know. Yeah. Again, I don't, you know, whether the wall of the canister, they also have overtax and you have to consider both. So, again, I don't, um, I don't think that you can make blanket statements. Um, you know, but again, it's very attack specific, but I, I don't think, you know, my personal view is that there are other design factors that are more important than the thickness of the canister.

Dr. Bart Ziegler: 01:31:52 Uh, ACE Hoffman has a question. Someone stole a tank in San Diego some years ago, a US pilot went crazy and flew his fully armed jet into the mountains during a training

flight. Do bullets Oh, oh depleted uranium bullets can easily go through many inches of steel and concrete, then burn inside the target. None of this is classified, nor are dozens of other weapons that can penetrate and destroy dry casks. How would you like to answer that big one?

Dr. Edwin Lyman: 01:32:28 I think I already did. Um, you need something more, you know, if you don't have, you don't have a fuel source inside these casks, um, that it's going to ignite with, um, you know, depleted uranium shrapnel still needs to be oxidized. You know, it's, um, you know, I think the point of my talk rather than is really that we should focus on what the required protection is and what it should be. Yeah. And I think the big issue here is that there is this gap, uh, between what the NRC staff themselves had identified as possibly plausible attack scenarios and what the current regulatory requirements say. And that gap itself is enough to be a concern. You know, I'm, I'm not gonna worry as much about, you know, kind of speculative, you know, missile attacks from foreign powers, uh, as the potential to use common or relatively common tools or techniques, uh, that, that are more readily available, but could be leveraged.

01:33:40 I think that's where our focus really needs to be. Or they're not, not not looking at the more exotic, uh, weapon systems, but also kind of garden variety stuff, uh, that might be weaponized in this context. And I can't say anymore because, um, um, I actually did have a security clearance, and I did, I was, uh, saw, uh, some of the data associated with this issue. Uh, so, uh, I don't wanna get any really specific and I can't. Um, but, uh, you know, I, I would just point to the fact that the NRC staff themselves identified, uh, this, uh, also, I think I mentioned this on the slide, that, um, uh, they did this proof of concept testing, and this is public. They went out in 2013 to white stand's missile range, and they tried to blow up mock spent fuel casts in various different ways. They took movies of them, and the conclusion was, well, some of the ideas they had weren't that effective, but others were. And, uh, so there's a gap. There are things that could be pretty bad, uh, but the NRC is not on a tr a trajectory to doing anything about him. That's, that's, uh, the, I think, the most urgent concern right now. Looks like we have another question,

SLF: 01:35:03 Dr. Lyman and Dr. Anderson. Um, Dr. Lyman, from just looking at all the questions, um, as the host, I would say I agree the biggest concern is the gap, but I guess the question would be what can we do as participants in this issue to help make that gap change?

Dr. Edwin Lyman: 01:35:27 Well, um, you know, there's always letter writing, and right now it's up to the commissioners, uh, the NRC commissioners to vote on what to do. They haven't voted yet, as far as I know. So if there were a public campaign telling them that they should not, you know, punt on this issue, uh, that they at least should go to the next, uh, stage, uh, and not rely on, you know, what seems to be a single sand national laboratory study if the NRC staff doesn't trust, but to, uh, further evaluation, uh, that, that, that that would be warranted. And also, you know, uh, uh, Congressman Levin, you know, is, is interested in this issue and, uh, you know, hopefully he may weigh in. Um, uh, but, you know, that's, you know, the, the ball is in the, uh, NRC commissioner's court right now. And, uh, I, I don't get a whole whole lot of sense that, um, they're that concerned about, or at least, um, the majority of the commissioners, um, seem to agree with the staff that they don't need to do anything. And I just, just looking at the whole history of this issue, I don't, I just don't see, uh, why that would be true.

SLF: 01:36:45 Can the states actively be more in a campaign status versus just a nationwide can The states rally together to do some petitioning?

Dr. Edwin Lyman: 01:36:58 Certainly, you know, the state governments are entities that have, you know, rights and, and, um, can weigh in at the NRC as, as any other, you know, um, interested party can. Um, and this, you know, this is an issue for any, any state that is hosting this seize, uh, especially those at decommissioning reactors. So I would hope, um, you know, uh, that more public attention on this would get the NRC to do the right decision, make the right decision.

SLF: 01:37:32 Thank you.

Dr. Bart Ziegler: 01:37:33 Speaking of, um, decommissioning, I, there's a question here from Linda Sealy who's with Mothers for Peace up at Diablo Canyon, and they're ab hopefully about two, according to the NRCS recent decision about to work on decommissioning there, she says, what are the other design factors that are most important other than the thickness of the casks or canisters?

Dr. Edwin Lyman: 01:38:00 Well, like, like I said, it's the, you know, uh, typically the, the greatest vulnerability are around the, the lids and the seals, because, um, and you know, mo most casks use a kind of vetoer seal, which loses its ceiling ability at, at relatively low temperatures. So when you do fire analysis for these casts, you have to show, you know, the, you know, we probably all know that the fire standards are relatively lax for waste packages, that it's only in half hour fire in debris Celsius. But the goal is to show that that won't cause the seals to fail. Uh, they're kinda the most vulnerable part. Um, and you know, it, it's not just the, the thickness of the material, but it's also the structural strength and the other properties it has, uh, which also go into, come into play. And again, I just, I just can't say generally, uh, that one is better than the other. Like I said before, uh, it's just a very complex type of analysis.

Dr. Bart Ziegler: 01:39:09 Wow. There are, Peter, should I just read some of these questions you think? Feel free. Okay. Cuz Bill Weigel says, do do you think, um, do you think it's a good idea to store this high level nuclear waste on a military installation, which makes it a legitimate target under the laws of war? Have we not just prepositioned a weapon of mass destruction for our enemies to use against us in time of war? Wow, that's sort of <laugh>.

Dr. Edwin Lyman: 01:39:41 You know, I, I try not, um, I don't know if I have a real response to that. Um, you know, obviously a, again, you know, the, the problem is that protecting against enemies of the state is out of the, you know, the NRC has said it's out of its purview. And, um, that in itself is a, is an issue not, not just for facilities like these, but for any critical infrastructure facility where, uh, that is potentially vulnerable to a military attack. So, um, so I think that's a larger issue, uh, that has to be addressed.

Dr. Bart Ziegler: 01:40:25 Okay. Uh, Paul Gunther says, Dr. Lineman, do you support on force drills at is Fases? Why has the NRC not proceeded with the rulemaking to initiate force on force exercises?

Dr. Edwin Lyman: 01:40:41 I think that would be, that should be part of the considerations if there were rulemaking going forward. Uh, and just to explain, uh, for operating reactors, uh, with that security force that has to ha mind an armed response and show they can interdict and neutralize this, uh, design basis threat, the NRC requires, um, uh, that not only the plan owners themselves do drills once a year, uh, actual full force and force drills to demonstrate that capability with their security force, but also the NRC inspects every three years running its own, um, uh, inspection with its own scenarios and, and its own, or well, using an industry-wide, um, composite adversary force as a surrogate, but ostensibly under NRC direction, uh, to test the security of these facilities. But all that goes away, uh, when the reactor shuts down, you just have the <inaudible>. But if, um, you have, you know, if there are potential scenarios where adversaries could get to the casks in a relatively short period of time, and, you know, uh, like at songs, um, you know, the, that security fence and the controlled area boundaries is pretty small.

01:42:06 And, you know, they, um, uh, if they could get, you need to know how, what the timelines are for them to get to the, where the waste is for them to apply these advanced techniques. How many tasks could they do at once, um, and how long would that, and what are the measures to prevent them from sabotaging those tasks? And, and you need to test that because if the current strategy is called 9 1 1 and get the local law enforcement to show up, uh, if this, uh, you know, if this unfolds too fast, that's not gonna happen. So, uh, full-blown, you know, exercises involving all the entities who are supposed to respond, showing they can actually do what they're supposed to do,

it would be critical. So, yes, uh, short answer is yes, I do think that should be part of this enhanced, uh, uh, regulatory requirement.

Dr. Bart Ziegler: 01:43:03 That, that's just a great answer because Daniel Hirsch writes, 20 years ago with Lockba, with Dave Lockba, they wrote an article for the Bulletin of Atomic Scientists criticizing NRCS design basis, the threat regulations for operating plants. Of course, at Santare Wheat, we have the waste dump there that is vulnerable, as you explained. It says, given the efforts to extend Diablo's operations, what can you tell us about the adequacy of nrcs current design basis threat requirements, Stan Hirsch, which is what you just sort of answered,

Dr. Edwin Lyman: 01:43:38 Right? And that's a whole, you know, that's a whole other fight because that, you know, um, this is a situation where the design base thread effectively doesn't apply anymore, no matter how, you know, what it is. Uh, but if you look at the, uh, the design basis threat for operating reactors that are serious questions about whether that is adequate. Um, and, um, and it's not just the, the threat itself, but how it's applied, um, and that, that's, that's really a subject for all of the talk. But the, the short answer again, is no, I don't think, uh, the, the, the changes that were made to the design base threat after nine 11, uh, were sufficient, uh, to really address the postulated threat or the, you know, the threat that we think does exist. Um, and it's not just the what's in the rules, but it's also their, again, their application and their interpretation.

01:44:42 And the whole other thing that I was involved in for a long time was, uh, what are the assumptions, uh, that are made about how these adversaries operate? What, um, what are the kind of rules for understanding the outcome of, let's say, force and force exercises or, um, and the industry was, was, has been pressing for more or less successfully is kind of bounding how the adversaries can even use the tools that they're provide in the design basis. Right? And, um, you know, I can't really say more about that, but it's, it's, it goes well beyond just what's in the regulations. Uh, and, um, uh, a more troubling or development is, again, related, um, is a separate proposal that would reduce the, um, responsibilities of the security force at operating reactors so that, uh, local law enforcement would actually have a more fundamental role, their response in plant security than is currently the case.

01:45:57 This is a very dangerous proposal, and again, a lot of the same, uh, ideas are similar, that you can't count on local law enforcement. They're not under the, uh, control of the licensee. They're not under the control of the nrc. The NRC has no authority to tell them what to do. Um, and unless if you give them more responsibility without ensuring that they can carry out that responsibility in some way, you're abrogating your regulatory authority. And that seems to be what, what the direction is, um, of things is going at the nrc. All, all very troubling.

Dr. Peter Andersen: 01:46:36 And, uh, quick question, local law enforcement, uh, is not only not under the direction nrc, uh, but they're not really prepared, are they for, uh, dealing with, uh, both an attack in the release of radiation? I mean, they don't, they don't have radiation gear that would protect themselves, do they?

Dr. Edwin Lyman: 01:47:01 Well, that, that would depend, you know, some local law enforcement, uh, may have specialized, uh, uh, personnel or some training that, you know, after nine 11, you know, there was more concern about radiological terrorism. Department of Homeland Security, uh, provided some funding. But again, it's not really, uh, you know, part of their normal operations. And it's not clear if that funding, you know, it's really, uh, sporadic. Who knows if it's been sustained, who knows if they're getting that kind of training, uh, that that's all part of the, this problem is that you, you, um, don't know if that response is going to be equipped to cope with this, uh, with the, uh, the potential scenarios. And unless you, um, ensure that they have the resources and the training and you test that they can execute, uh, these, these missions, then you're really just, you're exchanging something for nothing. Right. The, um, the, uh, for better or worse, those security forces at, at the plants as well as the onsite radiation protection and everything else, um, you know,

at least there's some regulatory control over them and their qualifications and, and everything else. And none of that, you know, it's just a, a black box, uh, with regard to what local law enforcement can or can't do.

Dr. Peter Andersen: 01:48:27 Thanks.

Dr. Bart Ziegler: 01:48:32 So, um, there could be some background leaks. That's also a concern. You know, we're worried about tsunamis and El Ninos and a whole bunch of fires and just disastrous, um, climate change. Um, but back to a concern that we have here at San Nore is if there's a, a cracked canister and it starts to leak, do you know about the UCSD's, um, essentially invention using, uh, simple detection manners to look at leaks ahead of time, early warning monitoring that's been developed here?

Dr. Edwin Lyman: 01:49:17 Yeah, again, I'm not really, no, not really prepared to talk about that. Um, you know, again, my, my, my deepest concern are those events that could really lead to catastrophic consequences. And, um, and making sure that there's adequate, uh, protection to make sure those events are, are very unlikely and, and can be dealt with. And so that's sort of where, you know, the focus of my concern is those highest consequence events, you know, routine releases or, you know, um, you know, again, it's a big subject and I'm not really prepared to talk about it today, but, uh, what I do know, you know, is that if there's the potential for a, a severe, uh, you know, energetic event that could really damage or even melt spent fuel in the cask, uh, that, that's, by that, that's orders of magnitude worse than what you would expect from, uh, a routine leak.

Dr. Bart Ziegler: 01:50:26 If you were to give us three or four take home points from this discussion, and, and it's just so wonderful that you took their time to, to, to uh, share this, this wisdom with everyone on the call, what would you say is the most I the pressing issues for santare at, at this time? Or any, any, yeah,

Dr. Edwin Lyman: 01:50:49 So, right. So to recap, um, you know, the NRC staff identified that the, um, uh, that the types of attacks that could plausibly occur, um, at a, at an fc, uh, that there are some that could lead potentially to worse radiation releases than what the current regulatory, uh, requirements assume. Uh, the n the NRC for more than 15 years has been kind of batting around the possibility of strengthening requirements. The industry is united and opposing any such increase in requirements, um, and through ups and downs, uh, this issue has stayed alive. But now, um, we're we're at the point where it could be shut down entirely. Um, and my belief is that the available evidence in public is sufficient, uh, to say that there do need to be increased, uh, security requirements for fcs, and the NRC is, uh, on the verge of potentially, uh, not fulfilling that, uh, responsibility.

01:52:04 And that's, that's a problem. And that would mean that, um, communities like those around San Freight are an undue risk of, uh, a large radiological release that not only would pose acute hazards, but also could lead to widespread radiological contamination that would make it difficult, uh, to live in, in some of these close communities. It could ruin, uh, the natural resource of the beautiful coastline. Uh, and, um, that, that, you know, that's a whole other issue is that the, the NRC doesn't even consider that, uh, in, its, in its dose requirements. All it looks at is someone standing at the fence line, you know, controlled area boundary, something happens, how much radiation are they going to get standing there? It doesn't look at what happens afterward. If you have, let's say, season 1 37 dispersed across the landscape, uh, that has a 30 or half life, uh, the NRC refuses to, uh, consider those kind of longer term issues in part as part of their analysis. And that's another gap you could have releases that may not exceed the regulatory limit at the fence line, but would still be a big problem for people within, uh, five or 10 miles on the site.

Dr. Bart Ziegler: 01:53:29 You know, there are 9 million people within 50 miles. It is, it's a nice place to live.

Dr. Edwin Lyman: 01:53:35 I know, <laugh>,

Dr. Bart Ziegler: 01:53:37 Peter, what do you say?

Dr. Peter Andersen: 01:53:40 Well, what, what, what would be the benefits of having a hot cell on site at Nore to deal with any potential disruption of, uh, one of the canisters?

Dr. Edwin Lyman: 01:53:56 Yeah, again, um, slightly side issue, but I do agree that, um, not having that capability at reactor sites, uh, is probably gonna be a problem in the medium to long term. And of course, you know, if, you know, if, if there were an attack, uh, even if it didn't lead to a large offsite release, you're still going to have a mess onsite. Uh, and without, uh, without available capabilities to address, uh, uh, the, the damage that, uh, that could be caused to the fuel in the casp, uh, that cask, you know, let's say there was significant damage to the fuel, but it didn't leak out. Uh, but still, you're not gonna be able to move that cask, you know, uh, the container maybe damaged, um, and you would wanna repack it, uh, and without that hot cell capability, I agree, uh, it's, um, it'll probably in increase the, uh, likelihood that that stuff is gonna stay where it is in its damaged state indefinitely.

Dr. Peter Andersen: 01:55:07 And even, even that small radiological release onsite that does not threaten neighboring communities, that would probably have some impact on interstate five. Would it not

Dr. Edwin Lyman: 01:55:26 Looking at how close, um, the FC is to the interstate as well as those, um, uh, you know, those, that, that diagram I showed you did, did show that how much, you know, the extent to radiation release within that hundred or 200 meters, uh, could be substantial. So, yes.

Dr. Bart Ziegler: 01:55:57 Um,

Dr. Peter Andersen: 01:55:59 Are there additional questions from our guests or panelists?

Dr. Bart Ziegler: 01:56:03 Oh, Michelle Lee says, isn't the fact that this is in the providence of the nrc, which has a conflict of interest, a key reason for concern, more confidence would come from scenarios developed by the military, military intelligence, cybersecurity experts with red team blue team exercises. What, how would you like to

Dr. Edwin Lyman: 01:56:24 Yeah, that, that's actually a very important point because, um, you know, a, after nine 11, the Department of Homeland Security was formed, it's, you know, part of its mission was to, uh, protect domestic infrastructure, but it got involved in turf battles pretty early on with the various agencies, uh, uh, with regard to their, the facilities that they regulate. So my, my reading of the history was that that Department of Homeland Security, I don't think really, um, had enough of its own independent technical expertise to challenge the nrc, the nrc, you know, you know, nuclear issues, nuclear physics, nuclear engineering, you know, just looks so complicated. You know, the NRC can kind of maintain the status within the inter-agency process of, you know, we're, we're the only ones who understand this, and that's intimidating. And I think that they were able to really retain that turf, uh, through intimidating other agencies, uh, with the technical, you know, opacity of so much of what they do.

01:57:36 And I think that's an ongoing problem, um, because other agencies do have equities in, um, how, uh, the NRC regulates these facilities is one example. Um, I was involved in a kind of short-lived effort that the Air Force had initiated, uh, that there was a concern amongst some of the Air Force that an electromagnetic pulse event, um, that would cause widespread grid, uh, failure, uh, could lead to severe, uh, you know, conditions, developing station blackouts and nuclear plants. It would affect, uh, reactors and spin fuel and air force bases that are, uh, near nuclear civilian nuclear power plants. Could be their, uh, activities could be severely compromised by radiation release. Uh, and so the air, you know, some of the Air Force, you know, tried to organize these meetings with the NRC, talk about their concerns, but ultimately, you know, the NRC prevailed with its, you know, technical, uh, it's overbearing technical posture, and, um, nothing happened.

01:58:49 The Air Force backed down, uh, for one reason or another. So, um, uh, I, I do worry that, um, that, you know, the NRC has seen sort of the be all and end all of decision making

with regards to civilian nuclear power. I mean, that's, their, their, well, that's what the law says, but they do have their own ways of doing things. They do have, they are compromised, uh, to some extent by, you know, by the conflict of interest, by the regulatory capture. And, um, there is no independent, real independent check on that, you know, you'd think the, um, as far as I know, as far as I can see,

Dr. Bart Ziegler: 01:59:37 I mean, there's, there's an interesting question here if we have, if we have a second from Mace Hoffman, about what do you think about ar gen's haws idea that would include separating the fuel into separate areas with berms, breach canister. Would that be useful? For example, if an airplane strikes or accidental intentional, perhaps one or two casts would be involved in the conflagration with physical damages?

Dr. Edwin Lyman: 01:59:58 Well, right. What I'm, what I'm really talking about is, is Haas or a regulatory, you know, requirement that would, could potentially lead to hostly HOAs like, uh, you know, features if it was shown that the way the current configurations of FCS were, were inadequate, and that could, you know, involve a lot of those hardening aspects that, that the HOAs includes, in fact, part of this decision that the NRC will make, uh, would also involve dismissing a petition. I think it was by, um, was it by C 10. People in the audience probably know that there was a petition a long time ago, uh, to adopt Haas, and that would be, that's really incorporated into this N R C uh, decision if they dismiss the need for new regulation in this area. You're also dismissing the petitioner on host.

Dr. Peter Andersen: 02:00:56 So if we were to do a letter writing campaign, uh, with our members, uh, uh, to the, uh, N R C, uh, what are the top two bullets that should be in those letters requesting them to do?

Dr. Edwin Lyman: 02:01:16 Yeah, I think the, um, the top bullet was, is we, um, were concerned about the inadequacy of current security requirements for fcs. Uh, the NRC has a chance to, uh, have a public process, uh, you know, to the extent possible, um, to, uh, review these concerns. And that, that would be the best way to do that, would be through a, a rulemaking, uh, where, uh, you would have a full regulatory analysis of, of what needs to be done, if you know, or what are the options for closing this gap? And, and security forums.

SLF: 02:02:02 And Dr. Anderson, Dr. Lyman, we are at the one hour mark. Are we open to a few more questions or just wanna

Dr. Bart Ziegler: 02:02:11 Do we have 30 seconds for one last question from Liz Shearer, whose, whose idea for the Coalition for Nuclear Safety, she says, what are the most important issues the community should address at this time for Santa Nore? And I think you've answered that a couple times.

Dr. Edwin Lyman: 02:02:27 Yeah. Again, this, um, I'm really highlighting one, one of the aspects that I think is most risk significant. That's why I focused on it now. You know, the thread of radiological terrorism sabotage is very hard to, to get your arms around, hard to define. Uh, but you know, I'm, I'm a firm believer that you need to, um, assume, uh, you know, the worst and, and prepare for it. And that includes, uh, uh, you know, a, a conservative view of these threats, especially as, um, you know, we'll have to see how the domestic subnational, extremist violent extremist threat evolves, uh, you know, since, uh, you know, the Trump era and, um, in January 6th, uh, and the infiltration of local law enforcement by these extremist groups, as well as another consideration, uh, that threat may be, you know, continue to be ascendant and with the fire power available, uh, to the general US population, you know, which, um, is extreme. Uh, then, you know, I, I do worry that organized, uh, conspiracies, uh, to cause this kind of radiological sabotage where attacking other critical infrastructure may continue to, to strengthen and, um, spent fuel. You know, it's here, it's here for decades. It's here for centuries. Who knows how long, you know, who knows what'll happen over those that period of time? Don't we wanna look forward? Uh, uh, and, and, uh, you know, rather than just lock everything into the way things are now since spent fuel is, is forever. We need to have, be more forward looking.

Dr. Peter Andersen: 02:04:22 Uh, Dr. Lyman, uh, on, on behalf of the Coalition for Nuclear Safety, thanks so much for some objective and enlightening comments. Uh, we, we greatly appreciate your expertise. You've given us some great ideas, uh, for future discussion, for future activities. Uh, Siegler, do you have any final words?

Dr. Bart Ziegler: 02:04:42 Yeah, you guys are volunteers. This is the, this is the generous, this is generous public service. I'm just so grateful to you, Dr. Peter Anderson and Dr. Edwin Lyman. Thank you very much for doing so well in the university and just achieving such, um, skills that you can share with, that you can air with all of us. It's just a pleasure to, uh, unite everyone together to find a solution. Thanks a lot.

Dr. Edwin Lyman: 02:05:09 Thank you. Thanks for having me. I appreciate it. Have a good weekend. Be safe.