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INTERVIEW WITH DAVID LOCHBAUM ON NUCLEAR ENERGY AND SAFETY POLICY

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David Lochbaum has served as Nuclear Safety Engineer for the Union of Concerned Scientists since 1996, leading UCS's efforts to ensure the safety of nuclear power by monitoring commercial nuclear power plants and identifying and publicizing safety risks. In the attached interview, Lochbaum discusses UCS's neutral stance on nuclear power and characterizes the organization's role as one of safety advocate rather than anti-nuclear activist. Lochbaum notes that replacement power sources that would be used in the event of nuclear shutdowns may not be good for the country. At the same time, UCS believes that future growth in U.S. energy demand can be met through renewable energy technologies and increased energy efficiency, and advocates for these technologies.

Lochbaum has become the leading intervenor in Nuclear Regulatory Commission proceedings and notes a generally successful relationship with the agency. He praises NRC for various improvements over the years, particularly the new safety oversight process which he believes will be good for both plant safety and economics because of the earlier detection and correction of declines in plant performance. At the same time he expresses no shortage of grievances with the agency, including charges that NRC's license renewal process does not allow a thorough review of plant aging mechanisms and prohibits intervenors from getting involved; that NRC's

risk assessments underlying "risk-informed" regulation make incorrect assumptions; that plants still do not meet NRC's 1980 Appendix R fire safety rules; and that NRC research has not provided sufficient benefits.

Lochbaum believes nuclear waste disposal can be accomplished in an "acceptably safe" manner for the long time periods necessary. He believes spent fuel should remain stored at operating reactors until a final repository is ready, but that spent fuel at permanently-shutdown plants should be moved to centralized storage in order to make way for decommissioning. Lochbaum closes with a critique of the industry's communications strategy and suggests that if people could be brought to trust the industry more, they might feel less resistant to license renewal and spent fuel management activities.

Prior to joining UCS Lochbaum spent over 17 years working at numerous nuclear power plants in a variety of safety-related capacities. He served as Senior Engineer for Enercon Services, Inc., System Engineer for General Technical Services, Reactor Engineer/Shift Technical Advisor for the Tennessee Valley Authority, BWR Instructor for General Electric and Junior Engineer for Georgia Power. Lochbaum received a B.S. in Nuclear Engineering from the University of Tennessee in 1979 and is a member of the American Nuclear Society.

The Union of Concerned Scientists was founded in 1969 by a group of faculty members and students at the Massachusetts Institute of Technology under the leadership of Nobel Laureate Henry Kendall and Professor Kurt Godfried. UCS has grown to roughly 70 staff members in five main program areas: agriculture, arms control, energy, global resources and transportation. According to Lochbaum the organization's number one issue today is climate change. UCS receives roughly half of its funding from its individual members. The remainder comes from grants from various energy foundations, including one large donor that funds UCS's nuclear safety work, and contracts with the Department of Energy for studies on renewable energy. Further information about UCS is available on their webpage at www.ucsus.org.

Numark Associates' interview with David Lochbaum is the second in a planned series of interviews of key figures in U.S. nuclear energy policy since we issued the *Nuclear Top Ten, 1999* report in April 1999. The interview can be accessed at www.numarkassoc.com/policy/lochbaum.htm. The *Nuclear Top Ten* report is also available on the Numark Associates website at www.numarkassoc.com/policy/topten/toc.htm.

DAVID LOCHBAUM
UNION OF CONCERNED SCIENTISTS



NA: Mr. Lochbaum, you are a nuclear engineer with experience working in the nuclear industry. Can you tell us what brought you to UCS?

Lochbaum: I was working at the Susquehanna Nuclear Power Plant in Pennsylvania as a contractor. We found some problems while doing analysis for a power uprate, which would have been made worse by the uprate. The utility didn't want to handle them, so we went to the Nuclear Regulatory Commission and didn't get a response at all. We ended up going to the United States Congress which then asked the NRC to look at it, which then forced the utility to fix it. The same problem -- this involved the spent fuel pools -- affected about 18 other plants in the country. Most plants in this country were built assuming that they would either reprocess or dispose of spent fuel. When that changed, the spent fuel pools became *de facto* waste dumps, but they weren't built with the backups and the defense in depth that everything else has. The problem has now been fixed.

NA: What was the specific issue?

Lochbaum: How do you handle the heat load? The heat load in the spent fuel pool in Susquehanna was five times larger than the heat load from everything else in the building combined, but it wasn't accounted for. So we said they either had to do something to remove the heat, or account for it being there in terms of equipment qualification. If heat load wasn't removed, it could have caused the building temperature to go up and affected the ability of equipment to operate correctly. Also, as the water heated up, that would affect the humidity in the building and a lot of the equipment wasn't designed to operate under that high humidity.

I subsequently interviewed for this job, in the summer of 1996. The three Millstone units had just been closed down. I didn't know about UCS, and what I had heard led me to believe that it was anti-nuclear. So when I interviewed I was lukewarm at best, because that's not my view. But the questions I got during the interview weren't "now that Millstone is shut down, how do we prevent it from restarting?," but rather, "how can those plants be restarted safely so old coal-fired plants aren't brought out of retirement to replace it?" I thought that was the responsible action, and the kinds of things I wanted to hear this group say rather than "how can we get the concrete trucks in there?" So that gave me comfort that this was the right position for me.

NA: Who decides UCS's positions and your policy on energy issues in general and nuclear in particular?

**NRC's new oversight process is much better than the old one...
We're going to be monitoring it.**

Lochbaum: Our position has historically been pretty well defined. We advocate safety, and we get engaged usually with the NRC in the areas where we think safety might be compromised or needs to be improved.

Periodically people from various perspectives want us to adopt a new position or want to challenge our position. The fact that we're somewhat on the fence on nuclear power issues -- we're not supporting it and not opposing it -- irritates people on both sides. We get people on both sides urging us to join their camp and often I just defer that to senior management up in Cambridge, i.e. my director Alan Nogee and our Executive Director Bud Ris, and let them fight that battle.

Some people in the industry have said to me that most nuclear plants are operating well so rather than focusing on the trouble plants why don't I champion and get

people to understand the good performers? I think that's NEI's job and they have a larger staff to do it. So if UCS can get the lower-performing plants to improve, that does no harm to the top-performing plants.

NA: Does UCS litigate?

Lochbaum: We did a lot, but we found it was very expensive and of questionable value. We found that we can be equally successful in other ways. It's the Nielsen Ratings effect: if you can get enough headlines and ink on something, you can get the NRC to look at it.

Watchdog Function

NA: How do you view NRC's performance and your role vis-à-vis the agency?

Lochbaum: I think the NRC has made improvements over the last few years, as Representative Markey commented in your report last year. We issued a report last November on NRC's new oversight process, which is much better than the old process. To me, just the fact that they engaged so many stakeholders over a two-year period and did self-examinations -- "What are our problems? What are our fixes?" -- is a good thing. Most of our time this past year has been spent on the oversight process, because we think that's the best protection over issues like plant aging, ownership changes, cost-cutting measures, deregulation, etc. This was tested at eight plants over the past six months and should be rolled out nationwide this spring. We're going to be monitoring it to make sure it reaches as many expectations as people have.

NA: How do you generally go about monitoring the NRC and the licensees?

Lochbaum: Typically, if we find an issue and try to contact the utility directly, they are apprehensive at best with UCS. So our normal course is to bring an issue to the NRC and let them determine whether it's right or wrong and, if there is a problem, to ensure that it's fixed. We try to be constructive with the issues we raise. We have been successful with our relationship with the NRC. We wish it would be a little bit easier, but at the same time I think we do have a good relationship with the Commission and staff. Occasionally I'll call the resident inspector at a plant, and I've been pleased with the response at all levels. Generally no games are played and there are no delays in getting back to me. It is much different going in there on

the UCS platform than on an individual platform because UCS implies a sense of persistence. We've been doing this for 20 years so they know we will follow up. We get good answers and have good communications with the NRC. I'm encouraged that we can continue to bring safety issues forward and have them looked at.

NA: I understand that UCS has monitored safety at ten representative U.S. plants?

Lochbaum: We did that for a 14-month period and decided not to continue it a second year because of the effort involved. We picked ten representative plants -- not the best plants or the worst -- and looked at NRC Inspection Reports and the reports that the licensee submits to the NRC, all publicly available information. We developed a scorecard to look at plant safety. Another group had ranked systems based on the number of events: the number of licensee event reports, the number of scrams, etc. Having worked in the industry, I didn't think that approach was necessarily meaningful because you could have a large number of licensee event reports because the utility was doing an aggressive turning over

of stones and finding a lot of stuff. If you just simply added up the numbers, that would make that licensee look bad, whereas a licensee that had no reports would come out looking good, and that's backwards.

NRC hasn't done such a good job with problem plants...Performance declines should be detected and corrected sooner, which is good from both the safety and economic standpoints.

So our scorecard looked at events. If they did everything the law required, they got a zero score, which was neutral. If they did more then they got a positive score and if they did less they got a negative score. We recognized that scores would be biased in the negative direction, because you typically report problems rather than positive things, but we felt that the bias would be consistent so we could look at relative performance among plants. At the end of the year we issued a report on those ten plants -- it's called *The Good, the Bad and the Ugly*, June 1998 -- and there were some surprises: Oyster Creek was one of the oldest plants in the country, but it ended up being the second best. It was operating at 30% above market cost for electricity in that region, so you'd think there would be a lot of economic pressure and you might expect cutting corners on safety, but we didn't find that. The best was the Surry plant in Virginia. It's a low-cost producer and it's also by our system a fairly good performer. We looked at why that occurred, how can it be a low-cost producer and also have good safety performance. We concluded that they have a good practice of identifying problems early and fixing them right the first time, which lowers cost and also improves safety. So you can achieve both if you do

an effective job.

Performance Improvements

NA: What do you think accounts for the increase in performance at US nuclear plants in recent years?

Lochbaum: I think it's two-fold: first, following the Three Mile Island accident there were a lot of extended outages as people implemented TMI fixes. Some of those modifications required the plant to be down and required plant outages of 60, 70, 80 days. It wasn't until the end of the 1980s that all of the plants completed those modifications. Then there were a few long outages due to steam generator repairs and other activities. With the real big ticket items out of the way, the outage lengths could start coming down and approach a duration dictated by refueling itself. The outages now are under 20 days in some cases. The average outage is down to the low 30's compared to over 60 days ten years ago. Second, the industry and the NRC undertook a scram frequency reduction effort to reduce challenges to safety. That's reduced the number of scrams from an average of six or seven a year 10 years ago to under two now.

Shorter refueling outages and fewer trips between refueling outages have boosted capacity factor. There's been a greater focus on plant output, but that doesn't necessarily mean exactly the opposite of

safety. You can do both. For example, power uprate takes up some of the margin that's built into the plant, but if that's done prudently and wisely and with forethought then that's acceptable. We don't have an issue with that.

We do think NRC in the past hasn't done such a good job with problem plants. In a report that we issued last November we listed 23 plants that had been shut down for a year or more in the last 15 years while safety problems were fixed. You could look at that and say, "well, it's a sign that the NRC's doing a good job because the plants were shut down for safety repairs." We took a slightly different interpretation in that if you had effective oversight, the problems would have been flagged before a year-plus outage was required to fix the safety problem. That's why we like the new program. It should prevent extended outages because performance declines should be detected and corrected sooner, which is good from both the safety and economic standpoints.

NA: How do you view deregulation's impact on safety?

Lochbaum: We're concerned about the reliability of the infrastructure. As utilities downsize and split apart between generation and transmission and distribution it's important to remember that a lot of the corporate support for nuclear power plants in terms of emergency response came from the corporate offices. The plant had the immediate response, but the off-site response came from corporate resources. In deregulation that may or may not be the same. We had some concern about if an accident were to occur, can the company cope with it the same way they could before? We've tried to attend some briefings that the NRC has had with FERC and others about the independent system operators and who is there to step in. We have been encouraged that the NRC has asked a lot of questions about that because they are concerned about grid reliability. NRC is asking the right questions, which gives me an excuse for not pursuing that more.

License Renewal

NA: With operator consolidation, an increasing number of plants are applying for license renewal. How do you feel in principle about going to 60 years of operation?

Lochbaum: 40 years wasn't drawn from a hat, but there also wasn't a lot of scientific basis for considering 40 years to be safe but 41 automatically unsafe. We're not suggesting that by any means. In theory, the plants could operate for 60 years because a lot of the plant

equipment is routinely monitored and replaced. The concern we have on license renewal is that the NRC's process is not allowing a thorough review of those aging mechanisms. UCS first got involved well before I came on board, with Yankee Rowe. Yankee Rowe had submitted the license renewal application, but it was going down that pathway when reactor vessel embrittlement was discovered. UCS and others got involved and ultimately the plant shut down about eight years early instead of getting a 20-year extension. That sent shivers throughout the industry. Here you are going for a 20-year extension and you end up shutting down early.

The NRC changed its rules after the experience at Yankee Rowe to basically prohibit anybody, groups like ours, from intervening at all. It is now a process rule. You can't question the quality of the equipment, whether it can last another 20 years. As long as the utility has an aging management program or can develop one, the plant can be approved for license renewal. And even if we review an applicant's license submittal and find that they haven't addressed containment aging or some aspect, all a

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company had to say is, we will develop one in that area and we're off the table. So they have structured it in a very unusual way.

As long as the safety issues are addressed, that is all we want. We are not looking for wins in how many plants we have shut down. In a specific case at Calvert Cliffs, there is some concern about its reactor vessel, similar to although not quite as bad as Yankee Rowe. What Calvert Cliffs' owners are doing is using the data from the Shoreham reactor which didn't operate very long and the McGuire reactor in North Carolina, both of which were built at about the same time, to give confidence in its own reactor vessel. I've said that if I was in the hospital with a major illness, I wouldn't want the doctor saying, "we're going to do surgery on you based on another guy who is about your age and weight and he says you need to get your spleen removed." I'd just as soon have it be my medical records that those kinds of decisions are based on. So we have some concerns about the process, because the way the NRC has structured it, we can't even intervene in a way to get discovery to get a hearing, to get a dialogue on those issues.

Future of Nuclear Power

NA: What do you see as the potential future role for nuclear?

Lochbaum: We issued a report a few years ago, before I got entrenched in UCS, called *Energy Innovations*, before the Kyoto COP-3 accord. It was our forecast of what energy demand would be until the year 2030 and what could meet that demand. Nuclear power was treated in that by assuming the existing plants would operate until the end of their 40-year lifetimes and then would shut down. There would be no new plants, or license renewals, but also no plants shutting down early.

I wanted to know why that was the assumption. There was a pretty strong consensus in the environmental community that nuclear power is not an answer to global warming, or to anything for that matter. In fact, the Earthday 2000 platform (*Editor's note: see <http://www.earthday.net/us/us-agenda.stm>*) calls for a phase-out of nuclear power in the U.S. as soon as possible. We do not oppose nuclear power and have not signed the platform. We do, however, agree with all the other aspects of the Earthday 2000 platform and are very much involved in the event. I don't agree with some of the other groups I work with. Some of them want nuclear power to be ended and are ready to bring in the concrete trucks. All we want to do is have it be safe.

We think that the energy demands in this country can be

met by renewable energy technologies and increased energy efficiencies. That is basically what the studies have shown. We also did a study that looked at the Kyoto numbers and came to the same conclusion. I am not even going to guess how many nuclear units will obtain license extensions. I don't think there will be any new nuclear power plants built in this country unless things change dramatically -- the capital costs are so high compared to combined-cycle gas and other options that it is just not likely to happen. And then you throw on the high level waste issue and all the baggage that nuclear power has, and it makes it less likely.

So UCS's position on the future of nuclear is neutral -- that renewables and energy efficiency are the main way to bring energy supply and demand together, and to replace nuclear power plants as they are phased out due to economics and coal-fired plants are removed from service. Alden Meyer, our Climate Change Coordinator, emphasizes that before you give nuclear power a second chance, give renewables a first chance. I agree with that. I find it disturbing that some quarters are attacking

renewables as being unable to meet demand. It was only about 45 years ago that nuclear power started with just four lightbulbs out in Idaho. A lot of money went into development and now there are over 100 plants in this country. So to compare technologies at different parts of their life cycles and say this one in its infancy can never become major seems to be a bit unfair.

Nuclear R&D

NA: What is UCS's position on advanced nuclear R&D, such as what DOE's NERI program is addressing?

Lochbaum: Over two years ago we provided some testimony before the President's PCAST Energy R&D Panel and they asked me the same question. We felt that if money is to be spent, it should be spent on ensuring safety at aging plants and solving the nuclear waste disposal issue. Before you start spending money on new toys there are certain things that need to be taken off the table.

NA: Do you support NRC's safety research programs?

Lochbaum: Not really. The biggest problems we see with the NRC's research programs is that we don't see where the applications are. I have a shelf full of NRC research documents, but I don't see that the results of those programs are factored back in or implemented. So it seems research simply for research's sake, and that's just a waste of money.

NA: How do you recommend dealing with the research results?

Lochbaum: To their credit, NRC's Director of Research, Dr. Thadani, has asked for our inputs into their research program, but we run a small shop and I just haven't been able to provide comments and recommendations to them. I've also had private meetings on this with some of the commissioners, and Commissioner Merrifield asked me for support because Congress was attacking the money they spent on research. I provided basically the same answer. I think if money is spent, there needs to be a closer tie-back to the application or the value gained from that. I don't mean to imply that everything has to be 100% effective, but it seems too far towards the other end. I'd like to see more benefit gained from the research.

Our perception is that the research hasn't led to any meaningful gains, and safety performance has been improving anyway. The conclusion might be that you could do away with that research altogether and still achieve safety performance, so that money is not necessary. If that perception is wrong, and the research actually led or contributed to those performance gains, then that's a different thing. But we don't have that position.

For example, when I was in the industry it seemed that when we needed a computer code to justify something, that was an excuse for the NRC to bring in the national labs. It seemed like money spent for no real gain because you could have used the vendor's code, or come to some understanding of whatever it took to gain confidence in the vendor's code or the utility's code, rather than have to go off on separate projects.

New Orders

NA: What are your views on what needs to happen with reactor designs before you could support or be comfortable with future plants being built?

Lochbaum: We did a study about ten years ago, before I joined UCS, called the Advanced Reactor Study. It was UCS-commissioned and done by the former MHB Technical Associates in California. They looked at five advanced reactor designs that were then being promoted in the industry in terms of safety. We concluded that none of them was inherently safe, but the high-temperature gas-cooled reactor was the one that offered the greatest safety gains and was the closest. With some of the other designs

there were problems where certain safety levels were assumed and so they didn't have some of the containment features. The overall conclusion of the study wasn't that we opposed any one of the designs. There were safety issues that needed to be addressed, and we thought one was head and shoulders safer than the others. But even the one at the bottom, we didn't take the position that it shouldn't be built, just that those safety issues had to be addressed before they were built.

In general the new reactors appears to offer safety improvements over existing plants. From our experience the biggest difference in safety isn't design; it is in the operation of the plants. There are only a few designs that are operating in this country, and there's a fairly narrow difference between them. The difference in performance is much, much larger. That's because there's good, effective management and there is management that has problems. You would probably find the same things in the new reactors. The issue is not so much the reactor designs; it's how they are built, maintained and operated.

NA: What about existing designs? What if some one wanted to finish construction of a partially-completed plant?

I find it disturbing that some quarters are attacking renewables as being unable to meet demand. It was only about 45 years ago that nuclear power started with just four lightbulbs out in Idaho.

Lochbaum: I think we've looked into the safety implications. As long as the safety questions were addressed, we wouldn't be out their championing it -- but we wouldn't oppose it either or lock ourselves to the fences. This Monday I was at a Commission

meeting that was looking into the restart of the D.C. Cook plant in Michigan that's been shut down due to safety problems. We didn't oppose the restart there because the safety issues that we had had been addressed. We have concerns with Browns Ferry Unit 1 that's been shut down since March of '85. We hear rumors that TVA could bring that plant back. There are issues that we would look at for a plant that's been in limbo for that long, but we wouldn't oppose it fundamentally.

NA: Can you comment about developing countries' potential use of nuclear technology?

Lochbaum: I think the MHB studies were independent of where the reactor is located. Clearly, once a plant is built the operation of the plant is a factor too. In this country the NRC, despite our criticisms of it over the years, seems to be a much more effective regulator than its counterparts in other countries. It's hard to do a comparison like that because the NRC's information is generally publicly

available except for security information and proprietary information. With those exceptions, most of NRC's successes and failures are publicly known, so we can then go in and see independently what the industry is doing and how well the NRC is doing. In France and Japan the information is not as readily available, so it's hard to assess performance at those plants relative to performance at our plants to see if it's because of the regulator or in spite of the regulator.

In general it is logical to think that a developing country won't have the infrastructure necessary to keep a plant safe. I wouldn't draw that conclusion up front for the same reason that we would have thought Oyster Creek would come out towards the bottom of our list. It didn't. There are factors to be concerned about, but I don't think it's an insurmountable obstacle.

On the other hand, from a practical standpoint developing countries might not have the electrical grid that nuclear power plants need in terms of availability of electrical power as a major contributor to safety. It seems that a smaller unit, where you don't need such a large grid infrastructure, is what a developing country would need more than one of our large central generating stations. Unless we downsize the plants, which could have some safety benefits, it doesn't seem like a practical solution.

Reactor Safety

NA: Coming back to the U.S., how do you view NRC's recent movement towards risk-informed regulation?

Lochbaum: The NRC is moving towards risk-informed regulation without having first built the proper foundation. The probabilistic risk assessments that have been performed to date do not provide a sound, technical basis for some of the safety decisions that have been made. For example, the risk assessments do not account for sabotage or terrorist acts. They account for random equipment failures and human errors, but they do not account for design errors. But the worst aspect of the risk assessments is that they simply do not reflect reality. They assume that all nuclear plants always meet all of their design and licensing requirements. The reality is that nearly 10 percent of the nuclear plants in the United States were closed during all of 1997 while literally thousands of design and licensing requirement deficiencies were corrected. The risk assessments belong in the fiction section of the NRC's library.

NA: Can you comment on the reactor safety issues of

greatest concern to you at present?

Lochbaum: I think a good illustration of a topic that shows a technical problem and a profit problem would be fire protection. We have advocated in front of the United States Senate and the NRC that fire safety at nuclear power plants is not where it should be. This is an organizational problem. UCS filed a petition in November 1977 following the Browns Ferry fire, showing that cable separation needed to be there, electrical connectors needed to be there, etc. The Appendix R rule was promulgated in May of 1980 by the NRC in response to Browns Ferry, but I don't think there is a plant in the country that meets that regulation today, 20 years later.

Many plants in the country know they are not compliant and are using fire watches, roving people who go around to make sure there are no parts of the plant that are smoking. Fire watches are good short-term compensatory measures. Ivan Selin, a previous NRC Chairman, testified before the Senate that fire watches are an interim measure. Seven years later we are still using them and there is no sign of them going away any time soon. It's not a "no-

never-mind." Fire safety, according to the individual plant examinations that plants have done, can comprise up to 68% of the overall core damage risk.

A related area is the fire seals that go around pipes and

conduit as they go through walls. In the 1980 rule, those fire penetration seals had to be non-combustible. But Underwriters Laboratory of Canada tested this material in the NRC-approved test procedure and it caught fire and was 95% consumed. This was the R2V Silicon foam made by Dow Corning and others. It's been used in all but two plants because it's easy to use to fill up around pipes because it is a liquid until it sets. But it's combustible which is in direct violation of the law. We brought this to the NRC's attention and they didn't understand why a fire penetration seal had to be non-combustible, and we tried to explain the value of that to them. Now they're going to change the rule and allow people to use combustible material. They've recently issued the new rule for comment. The rule change would bring the rules to match the plants, instead of the plants to match the rules. The industry is not pushing this rule change; they were happy with it being ignored. The NRC is pushing it because we pushed the Senate to get them to do something.

Another issue is plant security. NRC was conducting what they call Operational Safeguards Response Evaluations. The NRC decided to stop doing that after having done a few, and the few they did showed that there were problems

NRC's risk assessments simply do not reflect reality. They assume that all nuclear plants always meet all of their design and licensing requirements.

at every plant. We felt that was the wrong response to that indication. The Nuclear Control Institute was taking the lead on that. A story was published in the *Los Angeles Times* that got President Clinton involved. He called Chairman Jackson and all of the sudden the inspections were being done again, the next day. But now, the week after Chairman Jackson left the staff decided to do away with the program again. We think this is an important issue. The problem the industry has is that they don't see the tie between security and safety. They think security is just a lot of money for no reason. They don't think a terrorist will ever attack a nuclear plant. I don't know if they ever will, but if they do the consequences can be very great.

Nuclear Waste

NA: Can you comment on what you think is the feasibility of safe disposal of nuclear waste?

Lochbaum: I think it goes back to the "how safe is safe enough?" issue. I don't think you could ever guarantee that it could be perfectly risk free no matter where you put it. I think it's more likely that you could put it someplace where it is acceptably safe, recognizing that acceptably safe to me would be different than somebody else. But I think we could agree that there is probably someplace where you could put it where it could be acceptably safe even for the long periods of time it's intended to be isolated.

One thing we have taken a position on recently was the question of at-reactor versus centralized storage. Our position is that it makes sense to move the spent fuel from permanently shutdown facilities so you can fully decommission the plant. Taking the spent fuel from there to a Federal disposal facility or an interim site would seem to make sense, private or Federal. For plants that continue to operate, it doesn't seem to make much sense -- you still have spent fuel there, you still have a site, you still have security. No matter how you view the risks of transportation, whether they're high or low, if you move it twice, you've doubled that risk. That doesn't seem to make a lot of sense unless there's a very good reason for it, and we only think the first application provides that reason.

NA: How do you view at-reactor storage of spent fuel from the safety standpoint?

Lochbaum: There are some concerns on-site with spent fuel, and the spent fuel pool issue is the reason I'm with

UCS as I discussed earlier. We have some issues with dry cask storage whether it be at the reactor site or somewhere else. Dry casks are built, designed and licensed for a 20-year period and you can have up to four 20-year extensions for a total of 100 years. We would feel safer, more comfort, more confidence if they were 100-year designed and licensed casks and you only used them for 20 rather than the other way around. That would insure that the margins were there and a little more rigor would go in on the front end.

For example, some of the cask gaskets that provide the pressure boundary have failed. There's uncertainty about the materials themselves that are used to form the canister and some of the cask components. One cask has a weld that has already been identified as bad. There's no way to unload it right now.

NA: How serious are these things? What do you see as the worst case scenario?

Lochbaum: The casks are like the black boxes in an aircraft: when a plane goes down, everything is gone but the black box survives. The casks are pretty durable.

They are roughly 100 tons and have a limited amount of fuel inside. The very worst that could happen would be a criticality event. That's kind of remote. Absent a criticality event, the worst you can have is some leakage of radioactive

gas in small quantities, which is regrettable and poses a hazard to the worker who is responding immediately to the leakage, but not to the general public.

The fuel still in the spent fuel pool is a little bit different because it still has enough heat to cause overheating and fuel damage, even a meltdown in some cases, and there is much more of it. So you have kind of a domino effect where you could potentially affect much more fuel than in the dry storage case.

NA: You said that the chance of criticality in the dry storage situation is remote. What would have to happen?

Lochbaum: The most likely scenario is an external event either during shipment or during handling that causes either the lid or the integrity of the cask to be lost such that water or moisture can get in and provide a moderation source. The other possibility is if the canister for some reason fails and fuel gets closer together than intended, it's conceivable that you could have a criticality event, even absent moisture.

NA: *If this happened in a stored cask and nobody was around, how serious would the consequences be?*

Lochbaum: At the recent JCO accident in Japan, they didn't think they could have a criticality event so they had no way to deal with it. It would be harder to deal with it if it occurred inside a cask. It's conceivable that that could happen, but I think that's so remote that I'm not even sure I'd advocate having boron shields or other measures.

To me the greatest risk with the cask is just the 100 tons that it weighs, because of the risks as you're lifting it into and out of the reactor building. There have been studies done by utilities, such as Oyster Creek, of what would happen if they dropped a 100 ton cask. They found that it would go through five floors and end up in their torus. As it went through each of these five floors it would shake the building quite substantially. The electrical relay would shatter. Some equipment that wasn't running would start running, and some equipment that was running would not run. They weren't even able to predict what the consequences would be. So they didn't do that. They couldn't risk it. This study was done about the time Oyster Creek decided to either shut the plant down permanently or sell it, so they deferred resolving that. If the new owner wants to continue operating, they've filled their pool up, so they'll either have to bring a smaller cask inside or go to a single-failure-proof crane. Other utilities have done that; it's just more expensive.

NA: *So your bottom line is to leave the spent fuel at the reactor sites until the final disposal facility is ready, unless a plant is ready for decommissioning sooner.*

Lochbaum: Yes -- spent fuel storage is easier and of lesser risk than reactor operation. If reactor operation can be done safely, then spent fuel storage should be doable as well.

We have been asked a number of times, because Yucca Mountain is not available now or next year, shouldn't we shut down all nuclear plants today? We don't come to that conclusion, though we understand why other people would. There are over 100,000 spent fuel bundles in the US today that have to go somewhere, and if it's 120,000 rather than 100,000, it's only a slightly larger problem. Furthermore, if the decision were made to shut down all these plants, then what would replace that 20% of our electricity? There could be some adverse consequences.

When I was hired onto UCS there was concern about Millstone's permanent shutdown causing old dirty coal-fired plants to be brought back. Replacement power sources may not be good for the country.

Controversy over Nuclear Power

NA: *Nuclear power continues to be controversial. Your outlook seems to appreciate the risks as well as the benefits of nuclear power. Can you comment on the controversy?*

Lochbaum: Most people's first image of nuclear power is the mushroom cloud. It's tough to go from that image to the nuclear power plant in your backyard being a good thing. That's a huge perception problem. But coupled with that, the industry hasn't done itself any favors by how it communicates. It constantly denies that anything is a problem. Johnson and Johnson a few years ago had the scare with someone spiking the Tylenol. They came out right away and addressed the problem; they didn't say "your chances of getting poisoned by Tylenol are very low, so don't even worry about it." The industry needs to

make people trust it a little bit more, have more confidence in it, and feel less resistant to new plant license renewal or spent fuel, or any of the issues that are plaguing the industry today.

NA: *Have they gotten any better at it over the years?*

Lochbaum: UCS has occasionally raised issues at various plants where the plant spokesman immediately denies that it's a problem and then describes us an anti-nuclear group from Washington or an outside agitator. Occasionally a company will say "we're going to look at the concerns, we're going to evaluate." That is responsible. When you're blind-sided by some criticism, you don't know one way or another, but to deny it right off the bat seems counterproductive. Even at DC Cook -- which we feel somewhat responsible for having shut down for two years -- their first response to our concern was, "there's no merit to it whatsoever" and "he doesn't know what he's talking about and has never been to the plant." A different spokesman is now addressing those issues.

The rhetoric on both ends of the debate is polarizing. The University of North Carolina at Chapel Hill wants to have a debate on Shearon Harris' spent fuel storage expansion plans, between me and a company spokesperson. This forces you to go to the rhetoric stage, which makes for great TV but I would rather have a roundtable where you discuss the real issues.

If the decision were made to shut down all the nuclear plants, then what would replace that 20% of our electricity? Replacement power sources may not be good for the country.