Kay Drey 515 West Point Ave. University City, MO 63130

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Chief, Rules and Directives Branch
Division of Administrative Services (T 6 D 59)
US Nuclear Regulatory Commission
Washington, DC 20555-0001

Attn: Michael Masnik, Ph.D.
Fax: 301-415-3061

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Comments on the Draft Supplement to the 1988 "Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities."

The primary reason I am submitting the following comments is to urge the Nuclear Regulatory Commission to maintain its commitment to study the operating history and resulting contamination of each reactor on a site-specific, not generic basis — in its effort to design appropriate decontamination and decommissioning requirements for each site. Only in this way can there be any hope of achieving the requisite, long-term isolation of the contaminants from the human environment.

1. Site specificity: Many questions regarding decommissioning require site-specific and reactor-specific analyses. The Callaway plant, for example, here in Missouri, is located about 5.5 miles away from the Missouri River, the source of the plant's cooling water and the depository for its liquid effluent. It would seem that testing would be needed of the unusually long effluent-discharge pipe in order to determine where leakage may have occurred during the plant's operation and where soil excavation may therefore be required as a part of the decommissioning.

Sediment samples would be needed where the discharge pipe releases the plant's effluent into the Missouri River. Without such site-specific analyses, a determination of the extent of the riverbed's contamination would not be possible. According to a series of reports published in 1970, 1974 and 1976, by the US Environmental Protection Agency's Office of Radiation Programs, radioactive fission and corrosion products traceable to Dresden-One, Haddam Neck, and Oyster Creek had accumulated in those reactors' discharge areas in the Kankakee River, the Connecticut River and Barnegat Bay, respectively. (BRH/DER 70-1; EPA-520/3-74-007; and EPA-520/5-76-003).

Reactor contaminants in the sediments in the EPA studies included cesium-134 and –137, cobalt-58 and –60, manganese-54, and antimony-125. With evidence that these isotopes were able to bypass the liquid waste filters, it would seem probable that other fission, activation and corrosion products could have, too. And of course some reactor isotopes are extremely long-lived. I am reminded of the following discussion in a 1978 NRC publication on decommissioning:

> Based on the guidance put forth in [Atomic Energy Commission] Regulatory Guide 1.86 ["Termination of Operating Licenses for Nuclear Reactors," June 1974], entombment of a reactor facility requires the encasement of the radioactive materials in concrete or other structural material sufficiently strong and structurally long-lived to assure retention of the radioactivity until it has decayed to levels which permit unconditional release of the site. (In previous reactor decommissioning, it was assumed possible to entomb the reactor pressure vessel and its internal structures within the biological shield since the principle source of radiological dose was cobalt-60, which decays with a relatively short half-life (5.27 years). Thus, within about 100 years, the residual

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> radioactivity will have decayed to levels indistinguishable from normal background, well within the safe structural lifetime of the entombment structure. The presence of any niobium-94 was ignored. The amount of nickel-59 formed in the relatively brief operating life of these early plants was sufficiently small as to present no significant hazard. However, in large power reactors that have operated for 30-40 years, the induced niobium-94 and nickel-59 activities in the reactor vessel and its internal structures are well above unconditional release levels and, since nickel-59 has an 80,000 year half-life and niobium-94 has a 20,000 year half-life, the radioactivity will not decay to unconditional release levels within the foreseeable lifetime of any man-made surface structure. ("Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station," NUREG/CR-0130; pp. 4-5, 4-6; emphasis added)

Nickel-59, mentioned above, is produced when the nickel-58 in stainless steel captures electrons. Since the EPA found corrosion products in the sediment of several metals for which they tested, is it not possible that other metals subjected to the reactor's hostile environment (repeated cycles of temperature and pressure, high neutron fluxes, harsh chemicals, etc.) may also have degraded or dissolved, and migrated out of the plant? Could they be detected in the sediment if tested? Some of the corrosion products identified in the oxide layer ("crud") of various reactors include isotopes of iron, zinc, molybdenum, tungsten, titanium, and carbon. (I would be happy to send a copy of the comments I submitted to the NRC on July 16, 1980, regarding the Draft Environmental Statement on the proposed use of chelates to decontaminate Dresden One in Illinois. Information on chemical decontamination is cited from AEC, EPRI, GE reports, and more.)

2. **Rubblization:** This word is relatively new to me. But amazingly, the concept is not. I remember when our family first drove by the Elk River reactor in Minnesota on a brief, educational side trip with our children. This was some time before November 1974, when I first began reading and working fulltime against nuclear power. When we drove by Elk River again, four or five years later, the plant had completely disappeared.

Several years after that I learned from one of the former Elk River workers that they had used explosives to "dismantle" the plant. I was incredulous then; I still am. The list of explosives employed for the rubblization of this one small reactor is impressive, or more precisely, worrisome: PETN (pentaerythritol tetranitrate), 85% high velocity gelatin dynamite, cast TNT (high detonation pressure primers), binary energy system (liquid explosives) and water gel explosives. (From the revised "AEC-Elk River Reactor Final Program Report," November 1974, p.31). To quote further from that report:

> For obvious economic reasons, it was desirable to dispose of as much demolition debris as possible in local landfills. Because there were no burial facilities for radioactive materials in the State of Minnesota, and because of existing adverse public reaction to the nuclear industry from certain sectors, great pains were taken to insure that little, if any, radioactivity remained in the structures that were disposed of in Minnesota. For these reasons, the term 'detectable reactor originated radioactivity' or DROR was specified contractually and defined for this project. It should be emphasized that DROR as defined below is unique to the Elk River Reactor project, is a one-time requirement, and there is no intent to suggest a guideline for future decommissioning actions or to supercede guidelines issued by the [AEC] Director of Regulation. The term DROR was applicable only to demolition rubble that was to be left in the State of Minnesota and was defined procedurally by a special sampling and analytical method. (pp. F-4, -5)

Elk River was indeed a tiny reactor --- its net electrical output was only 22.5 megawatts, compared with the Callaway plant which was designed and built to provide 1120 megawatts and was subsequently, somehow, allowed to be uprated to 1171 megawatts. To quote further from NUREG/CR-0130:

> [Elk River had operated] for the equivalent of only 2.5 EFPY [effective full] power years] when it was dismantled. Thus, the concentrations of the longer-lived radionuclides in the Elk River reactor were quite small compared to the concentrations that will be present in a large PWR [pressurized water reactor] after 30 EFPY of operation. (p. 7-16; emphasis added)

I understand that Elk River is the only US commercial reactor that has been completely dismantled down to its original greenfield state. It so completely disappeared, in fact, that it is not even mentioned in the "Draft Supplement," in the tables of "permanently shutdown plants" (for example, at pp. 3-27, 4-44, and Table F-1). And speaking of Appendix F, by the way: please note in Table F-2 that the Callaway plant is located in Missouri, not in Montana.

It is extremely important for the NRC to level with the public about the potential hazards of the concrete debris and related rubble from the dismantled plants. The porous concrete floors get radioactively contaminated during the operation of the plant. "Radioactive corrosion products and fission products from failed fuel, which are transported throughout the station by the reactor coolant streams, are the principal contributors to the more mobile radioactive contamination on piping, floors, and pool surfaces." (NUREG/CR-0130, June 1978, p.7-15.) Radioactive products can also enter the primary cooling water from pin-hole leaks in the fuel rod cladding; from the fissioning of "tramp uranium" left on the surface of the fuel rod during the fabrication of the fuel; and out of defective welds at the top and bottom of the fuel rod. The cooling water gets contaminated, and it can and does leak onto the plant floors during various routine and accidental activities.

Radioactive fission gases that escape out of the fuel rods can also escape out of the reactor vessel. Some dissolved and entrained noble gases are released to the environment in the plant's liquid wastes. Some are vented or purged into the atmosphere. And some migrate into the porous walls, the base mat (floor) or other sub-grade concrete, or the dome or roof of the buildings. Radon gas, for example, once in the interstices of the concrete, can decay or break down into radioactive solid daughter products, such as lead-210 that remains radioactive for more than 200 years. Xenon isotopes that permeate the concrete break down into cesium, including Cs-135 with a half-life of 2.3 million years. And krypton, also a fission gas, breaks down into rubidium, and then into strontium. As was admitted during the years of nuclear weapons testing and fallout, cesium and strontium are notoriously radiotoxic. As daughter products of the fission gases, they could remain entrapped in the rubblized concrete, releasing radioactive particles and rays into the air for at least ten half-lives, or they could leach into the groundwater. The rate of dispersal of the radioactive and hazardous contaminants in the rubble cannot be accurately predicted. Natural phenomena, for example, could affect the susceptibility of the radiation to be released. (Regulatory Guide 1.86, p.2)

Because of the potential presence of highly radioactive "hot particles" in unexpected areas throughout the plant, particularly in the reactor containment building, the rubblized materials proposed for on-site disposal could be more than just "slightly" contaminated. Contrary to the Draft Supplement, at page 1-7, for example, I think it is important to note that the rubblization of concrete could have radiological impacts as well as non-radiological ones. This is of special significance if explosives are to be used for the demolition, which will generate radioactive fugitive dust.

How could the NRC, with its limited surveillance staff, make certain that each licensee would search conscientiously for contamination on the interior as well as the exterior surfaces of pipes, drain lines and ductwork? To what extent will chemical decontaminants be used? Chelating agents not only dissolve radioactive isotopes (such as corrosion products), but they keep them in solution and thus subject to widespread dispersal in the environment. (I likened this phenomenon to burying radioactive wastes with roller skates on.) If chelates are used during decommissioning, will the discharge water containing the dissolved, chelated radioactive wastes be kept isolated from the environment until the chelates are broken down?

You will perhaps be interested in the following comment by Robert Bernero, who at the time was the NRC's assistant director of material safety studies. He was quoted in a June 18, 1974, Miami Herald article as saying that "the NRC staff currently favors a policy that would require decontamination and dismantling after a unit is retired from active service. 'It doesn't make any sense just to seal up a nuclear power plant and leave it,' he says. 'An orderly society should select burial grounds for its nuclear waste. It should not expect to use power plant sites for that purpose.' " (emphasis added)

I find it hard to believe that the massive structures of concrete and steel reinforcing bars found in a typical commercial power plant could be rubblized. The complexity and size of the task seem overwhelming. What technologies could be used to dismantle the base mat of the Callaway reactor building, for example: 13,400 tons of concrete plus 1,470 tons of intertwined #18 reinforcing steel bars? Do most 1,000-megawatt pressurized water reactor containment buildings have similar base mats? How can the radioactive content of this structure be accurately estimated? If rubblization were technologically achievable, where on a plant site could the wastes be stored in perpetuity? Would that be above grade or below? Would a leachate collection system be required where the rubble is stored in order to monitor for potential impacts on the groundwater?

Since the NRC would no longer have regulatory authority over the site, what governmental institution or corporation would be entrusted with the long-term collection, monitoring and analyses of the groundwater samples? Who would determine if remediation were needed; who would be liable for the costs of off-site contamination or other accidents? Who would be responsible to protect against the inadvertent recycling of radioactively contaminated building rubble and soil into new construction or as fill, a possibility mentioned but basically discounted in SECY-00-0041, a letter about rubblized concrete dismantlement, from William Travers, NRC Executive Director for Operations, to the Commissioners (February 14, 2000)?

3. Costs: Because of current efforts to restructure and deregulate the electric power industry, decisions about decommissioning could be driven by economic considerations, not by safety --- by efforts to cut costs in order to stay competitive. I believe the electric utilities should not be relieved of liability for their decommissioned reactors.

Because of deregulation, the US public must rely more than ever upon the NRC to maintain its authority and responsibility to identify, assess and regulate the full range of potential, high-risk impacts of every commercial reactor --- before, during and following its decommissioning. The NRC is our only option.

4. **The threat of terrorism:** With terrorism now a legitimate concern in the United States, the potential of a suicide assault on a nuclear plant --- whether the plant is operable or decommissioned --- must be assessed plant by plant, not generically.

No facility exists for the permanent disposal of the nation's high-level waste (irradiated reactor fuel), and only one burial site, in Barnwell, SC, is currently available to most reactors for the rest of their wastes (their so-called "low-level" wastes, which ultimately could include the rubble and dismantled components from decommissioned plants). That one "low-level" waste facility, however, that is serving most of the nation, is expected to be closed in the near future to non-Southeast-US reactors.

Because of the lack of off-site disposal facilities, it is understandable that the NRC staff would be promoting rubblization, and on-site burial and bunkering of the rubble after decommissioning. According to the Code of Federal Regulations, Title 10, 50.82: "Decommissioning will be completed within 60 years of permanent cessation of operations." That time frame takes in all reactors in operation today. Even if off-site disposal space were available to host all the nation's decommissioning rubble, the cross-country transporting of such large volumes of waste would probably be prohibitively expensive and would no doubt be protested by the residents of the corridor communities.

The transformation of the nation's abandoned nuclear power plants into de facto waste facilities is worrisome from environmental, safety and national security standpoints. To quote from President George W. Bush's State of the Union address yesterday: "Our discoveries in Afghanistan confirmed our worst fears .... And the depth of their [our enemies'] hatred is equaled by the madness of the destruction they design. We have found diagrams of American nuclear power plants and public water facilities ...." (NYT, Jan. 30, p. A22; emphasis added)

Articles published for decades have predicted today's disturbing conundrum: The Wall Street Journal on October 12, 1977 --- "Scrapping the atom; U.S. is facing problem of how to dismantle used nuclear reactors; Agency hit for not having long-term burial plan; Tombs and mothballing; Can a big plant be cut up?" The Miami Herald on June 18, 1979 --- "Nuclear cleanup: Power plants generate a long-term dilemma." The Progressive in December 1977 --- "A Landscape of Nuclear Tombs: What will we do with deactivated reactors, and who will pay for doing it?" The Interdependent, of the United Nations Assn., September 1977 --- "How do you get rid of a dead nuclear plant?" Technology Review of MIT, June/July 1979 --- "Decommissioning Commercial Nuclear Reactors: Nuclear power plants do not last forever. In the United States some large commercial reactors are scheduled for decommissioning within the next 20 years and many others will follow. But the process and its costs are still subject to uncertainties."

The more I learn about nuclear power's radioactive waste, the more I wonder if and when its proponents will admit that no safe solution may ever be found.

5. Concerns --- from the past and into the future:

Surely the most surprising and disturbing pronouncement in the "Draft Supplement" appears on page 1-7: "The decommissioning process continues until the licensee requests termination of the license and demonstrates that radioactive material has been removed to levels that permit termination of the NRC license. Once the NRC determines that the decommissioning is completed,

the license is terminated. At that point, the NRC no longer has regulatory authority over the site, and the owner of the site is no longer subject to NRC regulations." (p. 1-7; emphasis added)

The federal government (the US Atomic Energy Commission and its progeny) initiated and funded the promotion of nuclear power. How, then, can it walk away from the long-term surveillance of the plant sites, even though it will have declared the residual radioactive contamination to be at permissible levels? As happened here in St. Louis at the Mallinckrodt Chemical Works, buildings and land contaminated in the years 1942-1957 were cleaned up to contaminant levels declared to be safe for unrestricted use by the public. Not many years later, however, some of those same buildings and open spaces were found to require major additional remediation because radiation standards had became more stringent, reflecting a greater understanding of the health hazards of radiation. Monitoring equipment also had become somewhat more sophisticated.

Concerns and unknowns about the decommissioning of nuclear power plants started many years ago. In January 1975, for example, Sheldon Meyers, as director of the EPA's Office of Federal Activities, included the following observation about the Callaway plant's draft environmental statement: "The section in the draft statement regarding decommissioning of the plant indicates the plant site may require long term surveillance after being shut down. This section should be expanded to provide an estimate of the length of the surveillance time and the length of time the land must stand unproductive. It should also identify who will be responsible for the surveillance activity and who will incur the cost." (published by the NRC in March 1975; p. A12, emphasis added.) Why has no one answered these concerns prior to now? Or are there no credible answers?

6. Some concluding comments:

I guess one of the reasons I wanted to comment on this "Draft Supplement" is because it so dramatically reflects the backward world of Alice in Wonderland and of commercial nuclear power: "Sentence first --- verdict afterwards." **Make a permanent mess first --- try to figure it out afterwards.**

Because I have been studying and opposing nuclear power for 27 years, it should not surprise you that my dream would be for America's nuclear electric utilities to expedite the shutdown of all their reactors. The questions raised above --- and I have many more --- are not meant to be hostile and are certainly not meant to suggest that decommissioning a reactor should be made more burdensome, dangerous or costly than its continued operation. On the contrary.

The longer the reactor operates, the greater will be (1) the levels of radiation to which the demolition workers will be exposed; (2) the volumes of radioactive waste generated and stockpiled; and (3) the risk of a major radiological emergency. And now I guess we should add, the greater will be the potential for acts of radiological sabotage or terrorism (as per 10 CFR Part 73).

The reactors must be decommissioned in a prudent manner that will seek to protect the health and safety of the workers and the public. In the United States we must rely on the Nuclear Regulatory Commission for its knowledge, guidance and surveillance. I hope that trust is warranted.

Sincerely,

Kay Drey