515 West Point Ave.
University City, MO 63130
December 27, 2000

Ms. Gail M. Good, Chief
Plant Support Branch, Division of Reactor Safety
US Nuclear Regulatory Commission – Region IV
611 Ryan Plaza Dr. – Suite 400
Arlington TX 76011-8064

Dear Ms. Good:

Thank you for sending information about the November 9 Regulatory Conference held at the Region IV office, regarding AmerenUE's failure to maintain occupational radiation doses at the Callaway plant "as low as reasonably achievable" (ALARA) --- during the tenth refueling outage (October 1999). The NRC has apparently criticized UE for its having "scheduled outage activities to reduce the outage duration rather than to reduce dose, [and] failed to properly train workers in dose reduction methods . . . ." (NRC Inspection Report #2000-17 Summary, with 10/4/00 cover letter; emphases added) This letter is to request additional information.

1. In the middle of the refueling outage, AmerenUE decided not to revise its original occupational radiation dose projections even though the projected levels were already being exceeded. According to UE's August 21 letter to the NRC, UE's reasoning was "to avoid worker let down as work progressed toward achieving the original goal." Would you please tell me how the NRC interprets "worker let down"? (ULNRC-4298, p.3)

2. May I please have a copy of the NRC Inspection Procedure 71121.02 regarding ALARA Planning and Controls? Would you please tell me how to obtain a copy of the "Occupational Radiation Safety Cornerstone"? And, is it possible to access the Callaway "Suggestion-Occurrence-Solution" reports online?

3. Has the NRC Staff made its decision as yet regarding whether to classify UE's high collective doses during Refueling Outage 10 as "white" or as the lesser category, "green"? That is, have you decided whether increased NRC oversight is warranted, or not?

4. Was the confusion about the term "job" resolved as a result of the November 9 conference? I remain uncertain as to how or whether that word relates to the "collective radiation dose."

5. At the November 9 regulatory conference UE apparently blamed its difficulties during the refueling outage in part on a "lack of incentive to get experienced personnel to return for outages" and on "worker inexperience." If you asked UE at the conference why it had employed inexperienced workers for the refueling, did you receive a satisfactory response, and if so, would you please tell me what it was? (NRC letter to UE, Nov. 15; Enclosure 2 – "Licensee Presentation," pp. 10, 12)

6. What foreign object(s) was(were) retrieved during the outage? (NRC IR #2000-17, p.8)

**Some questions about the steam generators:**

7. Did the NRC Staff know that UE was planning to replace its steam generators in the year 2005 when it decided to approve the experimental steam generator tube electrosleeving during the October 1999 refueling? (As no doubt expected, the steam generator retrofitting did indeed cause many workers to be exposed to high levels of radiation because of the notoriously high radiation fields that exist in, under and near all nuclear steam generators.)

8. **(a)** Would you please tell me how many individual workers participated in the steam generator activities – that is, including the removal and installation of the steam generator manway covers and inserts [8.543 person-rem collective dose]; the eddy current/robotic plugging/stabilizing/ electrosleeving **[57.659]**; and the health physics support for primary and secondary steam generator activities [5.641]? (NRC IR #2000-17, Encl. p.4); and **(b)** What was the highest accumulated exposure of an individual worker during the steam generator job(s), and what was his or her craft?

**Some questions about the fuel core:**

9. As I understand it, a severe reactor fuel axial offset anomaly was first detected at Callaway during the plant's fifth operating year (May 1989-September 1990) – that is, an anomalous shifting between levels of power and temperature in the upper and lower portions of the fuel core. This anomaly potentially can generate such significant risks as local power peaking of the fuel rods, a reduction in the shutdown margin, and anomalous control rod positioning and fuel rod cladding temperatures. **(a)** Does Callaway still hold the record as having experienced the largest axial offset known (-15 percent, according to the NRC's IR # 1997-19, p.4)?
**(b)** Was the axial offset anomaly addressed during the tenth refueling outage, or if not, when was this problem resolved at Callaway?

10. I have long been concerned about the fact that the nuclear steam supply system at US reactors is being exposed to operating and environmental conditions that differ from those for which the NSSS (its components, structures, systems and parts) was designed. For example, today's fuel is kept in the reactor vessel longer (with this higher "burnup" causing extended fissioning and irradiation; pressure, temperature and humidity fluctuations; and fuel-rod cladding degradation); the permissible core power limits have been uprated; and, as described below, the fuel enrichment levels and resulting fissioning rates have been increased.

At the time the Callaway plant was ordered and designed, the uranium fuel in a typical pressurized reactor was enriched with fissionable uranium-235 at a weight percent of 3.2, with a lesser percent in the initial load. (Anthony Nero, Jr.: A Guidebook to Nuclear Reactors. Berkeley: University of California Press, 1979, p.81).

According to the "Callaway Plant Final Safety Analysis Report -- Site Addendum" (June 1986 revision), Westinghouse had designed the nuclear reactor/steam supply system to operate with the first core enriched as follows: 2.10 (Region 1), 2.60 (Reg.2) and 3.10 (Reg.3). [Region 3, I believe, is located at the periphery of the core.] "Beginning with Cycle 2, reload fuel incorporates the Westinghouse Optimized Fuel Assembly design. The enrichments for Cycle 2 reload fuel at Callaway are 3.40 and 3.80 weight percent." (p. 4.1-1)

**(a)** Would you please describe the composition of the current Callaway fuel core, following the $10^{th}$ refueling --- that is, the number of fuel assemblies of each U-235 enrichment level; the number of control rod assemblies and the number of control rods in each; and the number of

burnable poison rods used during and subsequent to the 10th refueling? (I am particularly interested in learning if any of the fuel is enriched at greater than 4.6%, which I believe is the highest enrichment level I have read about at Callaway.)

**(b)** Has UE, Westinghouse or the NRC determined whether the higher enriched fuel, in a batch of split-enrichment fuel, can contribute to axial offset, power peaking or crud buildup?

**Some questions about crud, the highly radioactive corrosion products at nuclear power plants** – but first, some comments:

I have been very much interested in crud for more than twenty years because of concerns about the exposure of nuclear power plant workers to radiation. The NRC and the nuclear industry have long recognized the risks to which pipefitters and others are exposed who must try to weld, repair or replace leaking pipes, valves and other components that are encrusted inside and out with radioactive corrosion products ("crud"). While most pipes ultimately corrode, the corrosion products (rust, etc.) of nuclear reactor metals --- zapped by neutrons --- are radioactive and uniquely feature cobalt-58 and –60 and other isotopes that emit highly penetrating gamma rays. The workers' nylon jump suits (or are they Tyvek now?) do not provide adequate protection.

<> In his September and November 1975 Nuclear News columns, Bernard Verna described the hazards of crud at Indian Point One (a now-decommissioned reactor near New York City) as follows: In order to repair defective welds in steam generators, welders had to work in radiation fields that were extremely high because of "primary side crud deposits." Each worker was limited to about 15 minutes in the work location. Mr. Verna reported that the repair effort took about eight months, using 700 men. "A similar repair effort in a conventional [coal-fired] plant would have taken about two weeks using 25 men."

<> Just one piece of cobalt-60, less than two inches square --- from one of the Indian Point One generators --- emitted one rad per hour.

<> Back in 1984, at Rancho Seco in California (also now decommissioned), a piece of crud from a steam generator was found which measured only two inches long, one-half-inch wide, and one-tenth-inch thick, and yet it emitted 120 rads an hour. (As you know, a worker's permissible internal-plus-external dose is currently 5 rads a year.)

11. Regarding the crud removal activities during the refueling outage: to what extent does the NRC Staff estimate the high collective worker doses were attributable to the buildup of crud on the fuel rods and elsewhere in the primary cooling system, in the secondary cooling system, and in other out-of-core locations? (An additional question about which I'm just curious: does the nuclear industry still call the crud in the secondary cooling system "the green grunge"?)

12. To what extent was the crud on the reload fuel rods/assemblies removed by ultrasound, before placing the fuel in the spent fuel pool for storage during the outage, or after removing it from the pool prior to replacing it in the reactor vessel? Was that job performed by robots? If not, what was the estimated collective dose of the decontamination workers?

13. If UE monitored the cobalt-58 and –60, and other dissolved or dislodged corrosion products that accumulated in the reactor coolant during the refueling outage --- to assess the efficacy and efficiency of the crud removal activities --- would you please tell me the total number of curies calculated?

14. Were chelating agents used to dissolve the crud during the refueling outage? Are chelating agents or other solvents allowed to be added at Callaway as a part of the primary or secondary coolant water chemistry while the reactor is on line?

15. **(a)** Do you know if more than one reactor coolant system crud burst occurred during the refueling outage? (Apparently at least one occurred while the workers were installing the scaffolding in the Reactor Building, as cited during UE's presentation at the November 9 regulatory conference. Encl. 2, p.12) **(b)** Could you please briefly describe a crud burst? **(c)** To what extent was(were) the crud burst(s) responsible for the **46.345** person-rem dose experienced by the scaffolding workers? **(d)** How many workers were exposed during the scaffolding activities? **(e)** Were members of crafts other than carpenters included in that total collective personnel dose? **(f)** What was the highest accumulated dose of an individual worker during the scaffolding job(s), and what was his or her craft?

**And one final question -- about valves**, based on UE's Oct. 9, 2000, letter to the NRC (ULNRC-4321):

16. According to the Callaway Licensee Event Report #2000-5, dated September 7, 2000, UE discovered in September that surveillance testing of the automatic isolation valves BNHV8812 A and B (at the interlock between the pumps of the Residual Heat Removal containment sump and the Refueling Water Storage Tank) had not been performed every 18 months as required by the Callaway Technical Specifications. In fact, the valve surveillances had been overlooked since the plant first became operable, fifteen years ago.

Apparently UE had performed maintenance testing of a portion of the circuitry for Valve B during the Refuel 10 shutdown, in October 1999, and of the rest of the circuitry for Valve B in August 2000. But since the valve surveillances can only be performed when the plant is not operating at power, would you please tell me when UE expects to test the Valve A circuitry, and the rest of the mandatory tests (thus far overlooked) of both Valves A and B?

I've often thought that my letters to the NRC must read like some sort of a take-home exam. Perhaps this letter, at least, would have been shorter if I had been able to listen in on the November 9 video-teleconferenced meeting on November 9. Or maybe it would have been longer.

Your response will be greatly appreciated, and you have my best wishes for 2001.

Sincerely,

Kay Drey

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