September 12, 2008

Ms. Kay Drey
515 West Point Avenue
St. Louis, MO 63130

SUBJECT: RADIOACTIVE WASTE GENERATED AT THE CALLAWAY NUCLEAR POWER PLANT

Dear Ms. Drey:

I am responding to your letter of August 4, 2008, to Chairman Klein, in which you requested responses to several questions that arose during the July 9, 2008, public outreach meeting for a potential new reactor at the Callaway Nuclear Power Plant site. Enclosed are responses to your questions regarding radioactive waste generated at the operating Callaway Nuclear Power Plant and the proposed new unit.

Sincerely,

/RA/

Michael R. Johnson, Director
Office of New Reactors

Project No. 750

Enclosure:
As stated

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ADAMS Package Number: ML082381293 **Incoming: ML082260196** **Response: ML082381295**

OFFICE	PM:RAP1:DSER	TECH ED: ADM	BC:RAP1:DSER:NRO	D:DSER:NRO	OGC
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OFFICE	DD:DWMEP:FSME	D:DIRS:NRR	D:NMSS	D:NRO	
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DATE	08/29/08	08/29/08	08/27/08	09/12/08	

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Response to August 4, 2008, letter regarding radioactive waste generated at the Callaway Nuclear Generating Station

Question A.1.a.:
For how many years does the Nuclear Regulatory Commission (NRC) expect to allow Ameren to provide "extended interim storage" for its B & C wastes on site at Callaway, in accordance with the NRC's Regulatory Issue Summary (RIS) 2008-12 (May 9, 2008)?

Response:
It should be noted that the NRC's RIS 2008-12 does not apply to the Callaway plant. It was developed specifically for materials and fuel cycle licensees. NUREG-0800, the reactor standard review plan, contains guidance on the storage of low-level radioactive waste (LLW) for nuclear power reactor licensees. The NRC is also currently reviewing reactor LLW guidelines submitted by the Nuclear Energy Institute (NEI) on May 13, 2008, and may endorse that report, either in part, or in its entirety, in the near future.

Appendix 11.4-A, "Design Guidance for Temporary Storage of Low-Level Radioactive Waste" in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," states that "While it may be prudent and/or necessary to establish additional onsite storage capability, waste should not be placed in contingency storage if it can be disposed at a licensed disposal site." Absent disposal options, Class B & Class C wastes could be safely stored for the life-of-the-plant, if necessary.

Question A.1.b(1):
According to that RIS [RIS 2008-12]: To the extent possible, licensees may wish to estimate the total life-cycle financial burden of extended interim LLW storage (including but not limited to operations and maintenance, inspection, and monitoring, and eventual disposition) and provide this estimate to organization decision makers for overall budget consideration. (p5, emphases added.)

Regarding the phrase, "eventual disposition," above: As of the passage in 1985 of the federal Low-Level Radioactive Waste Policy Amendments Act, Missouri began negotiations with co-member states in the Midwest Regional Compact in order to choose the first Midwest site. When Michigan became the first designated host state, it withdrew from the compact. Does the NRC know of any state in the Midwest or the nation that has expressed its willingness to install and operate a disposal site that might accept B & C "low-level" wastes from any of the 36 States now banned from South Carolina?

Response:
Although the Barnwell site closed to many U.S. generators on June 30, 2008, most LLW can still be disposed of at EnergySolutions in Utah. LLW has been safely stored in the past and can be safely stored at generators' sites in the future, when necessary. In 2007, the amount of Class B and Class C waste disposed of by the existing Callaway plant was one shipment for volume reduction prior to disposal. A company has an application to develop a new LLW disposal facility in Texas for waste generated within Texas and Vermont, two of the 36 States that generate waste. This proposed facility is designed to accept Class A, Class B, and Class C waste. LLW generators and waste processors are continuing to take steps to minimize the generation and improve volume reduction of LLW.

Question A.1.b.(2):
Is any NRC licensee discussing with the NRC the possibility of developing a disposal site for B & C wastes within surplus acreage at a nuclear power plant site? For example, Ameren owns surplus land that is not needed for the current Callaway reactor, nor for the proposed second reactor. That is, of the 7,200-plus acres Union Electric initially purchased in the 1970s for the construction of four reactors, more than 6700 acres are currently being leased to the Missouri Department of Conservation (MDOC) for use as the Reform Conservation Area, for public hunting and fishing. (The MDOC advises that when the National Security Level reaches orange or higher, the RCA may be closed to public use.)

Response:
The NRC is not discussing disposal site development at a nuclear power plant site with any licensee. The Low-Level Waste Policy Amendments Act of 1985 specified procedures for the implementation of LLW compacts that would establish and operate regional disposal facilities for LLW. Three operating LLW disposal sites (the EnergySolutions facility in Barnwell, SC; the EnergySolutions facility in Clive, Utah; and the U.S. Ecology facility in Hanford, WA) have accepted almost all LLW generated during the last 15 years. Additionally, a company has an application to develop a new LLW disposal facility in Texas for waste generated within Texas and Vermont. This proposed facility will accept Class A, Class B and Class C waste. Although none of the remaining States that generate waste are developing a disposal facility for Class B and Class C wastes at this time, waste can be safely stored onsite until such time as new disposal options become available.

Question A.1.b.(3):
Is the NRC discussing with Ameren the possibility of requiring the construction and operation of expanded storage capacity within the Callaway plant site for the primary and secondary solid radioactive wastes from the current reactor? For example, the existing Radwaste Building's Drum Storage Annex was estimated to provide temporary storage capacity for only "approximately 2 years of primary [reactor vessel system] drummed solid wastes." (Callaway Plant Final Safety Analysis Report for the Operating License, June 1986, p 11.4-13) Or another projection: "The onsite storage facilities for drummed solid wastes have a capacity for temporary storage of solid wastes resulting from up to 5 years of plant operation." (Ibid. p. 11.4-2)

Response:
There are no discussions underway with AmerenUE regarding the possibility of requiring the construction of expanded storage capacity within the Callaway plant site for primary and secondary solid radioactive wastes from the current reactor. AmerenUE must perform an evaluation to ensure that radioactive waste can be safely stored onsite for extended periods of time. If an unreviewed safety question arises, then AmerenUE must submit a license amendment application to address the safety question. If no unreviewed safety questions are identified, then AmerenUE should document the evaluation under the requirements of Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.59 (10 CFR 50.59), "Changes, tests, and experiments," of the *Code of Federal Regulations*. The documented evaluation will be available for review by NRC inspectors.

Question A.1.b.(4):
Has the NRC staff estimated or calculated the life-cycle financial burden of storing and protecting, within a nuclear plant's site, the B & C wastes that are generated annually by a typical 1000-megawatt reactor during the licensed operating period, and beyond? Have the costs been estimated of possibly having to store and guard the LLW that will be generated

during the decommissioning and dismantling of a power plant's radioactively-contaminated buildings and equipment after the plant's closure, for an indefinite period?

Response:
The NRC staff has not estimated or calculated the life-cycle financial burden of storing and protecting the Class B and Class C waste. The NRC has not estimated the costs of having to store and guard LLW generated during decommissioning. However, NRC evaluates the cost of disposal as part of the biennial financial assurance review.

Question A.2.a:
Questions about potential environmental impacts of the extended interim storage on site at Callaway of the reactors' B & C wastes:

According to Regulatory Issue Summary 2008-12, in order to "ensure the integrity of packaging and maintenance of waste form" during extended storage, the NRC is requiring the following: "stored waste packages should be protected from the elements (e.g., wind and precipitation) and from extremes of temperature and humidity. To the extent that circumstances make it impractical to provide such protection from climate, the licensee may wish to determine how it will maintain package integrity and prevent the release of stored LLW despite the exposure of stored waste packages to the elements (RIS, p.3)."

The current Callaway radioactive waste systems and structures are designated as nonseismic Category I. (Callaway Plant Operating License FSAR, Rev. 0, 6/86. p.3.2-2) Because of the need to begin storing B & C wastes on site into the indefinite future, will the NRC now require that the radwaste storage structures be retrofitted to seismic Category I standards in order to withstand a safe shutdown earthquake? And to withstand the effects of a tornado and other extreme wind and environmental conditions?

Response:
Waste classification criteria are addressed in 10 CFR 61.55, related to LLW packaging for off-site transport and disposal. The RIS cited in the question provides a caution to licensees to ensure integrity and stability of waste packages. The criteria for storing LLW at nuclear power reactor sites are outlined in Generic Letter 81-38, "Storage of Low Level Radioactive Wastes at Power Reactor Sites."

The radwaste building at the Callaway plant is designed and constructed using the provisions of Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants." This guide requires the use of operating basis earthquake for seismic design, and requires the consideration of tornado loading according to the American Nuclear Society Standard 2.3 at a frequency of 1×10^{-5} /yr or three-fifths of Criteria in Regulatory Guide 1.76, Table 1. Radwaste systems and structures are designated as nonseismic Category I. The radwaste building is designed for the Operating Basis Earthquake. At this time, there are no plans for the NRC to require radioactive waste storage structures to be retrofitted to seismic Category I standards. The existing Callaway radwaste building is substantially rugged with respect to earthquakes, and because the building extends 33.5 feet below grade, it provides considerable protection from missiles and other effects from tornados.

Question A.2.b:
If the proposed second, larger reactor were to be built at Callaway, would the NRC require more rigid safety-significant construction standards for the second Radwaste Building and Drum Storage Annex, in order to withstand the rigors of extended storage?

Response:
The NRC staff will review the design of the radioactive waste building proposed for the new reactor in accordance with Standard Review Plan section 11.4, Solid Waste Management System (NUREG-0800, Rev. 3, March 2007). By following this Standard Review Plan, the NRC ensures that the applicant complies with General Design Criterion (GDC) 61, "Fuel Storage and Handling and Radioactivity Control," of 10 CFR Part 50, Appendix A. GDC 61 requires that systems containing radioactivity shall be designed to assure adequate safety under normal and postulated accident conditions, and the design of such facilities shall enable inspection and testing of components important to safety, and with suitable shielding for radiation protection.

When determining if the applicant complies with GDC 61, the NRC staff will compare the radioactive waste building design to the structural design criteria in Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants" (Rev. 2, November 2001). This Regulatory Guide furnishes design guidance acceptable to the NRC on seismic and quality group classification and quality assurance provisions for waste management structures. The design guidance contained in this regulatory guide is based on ANSI/ANS Standards 55.1, 55.4, and 55.6; the Uniform Building Code of 1997; and the American Society of Civil Engineers 7-95; all of which account for the building and structural loads expected for the life of the plant.

Should the applicant propose an additional storage facility external to the proposed Radwaste Building itself to extend waste storage capacity, the NRC will use the criteria in Regulatory Guide 1.143, Section 5, "Classification of Radwaste Systems for Design Purposes," and Section 6.2, "Buildings Housing Radwaste Systems," to assess the facility design. This again includes the same standards listed above for building classification and quality assurance requirements based on certain criteria such as quantity of material stored and adequate safety under normal and postulated accident conditions.

Question A.2.c:
Are the four huge, highly radioactive steam generators that were removed and replaced at Callaway One, during the 2005 refueling shutdown, still being stored on site? And if so, was the storage structure housing the generators designed to withstand a design basis earthquake and other natural phenomena hazards?

Response:
The four steam generators are still being stored on site. The Old Steam Generator Storage Facility (OSGSF) was designed to provide storage of the old steam generators removed from the Unit 1 containment as part of the Callaway steam generator replacement project. This structure and its contents are completely passive and are not required to be built to Category I seismic requirements. NRC guidance related to storage of low level waste at power reactor sites is provided in Generic Letter 81-38, "Storage of Low Level Radioactive Wastes at Power Reactor Sites," such that the radiological consequences of design basis events (fire, tornado, seismic event, flood) should not exceed a small fraction of 10 CFR Part 100. The concrete wall and roof of the OSGSF are designed for both structural integrity and radiation shielding in accordance with the requirements of 10 CFR Part 20, "Standards for Protection Against Radiation". The building was designed to withstand wind speeds up to 70 mph and designed to

withstand seismic loads in accordance with the requirements of BOCA (Building Officials and Code Administrators (BOCA) International, Inc.) for a Seismic Hazard Exposure Group III structure with Seismic Performance Category C.

Question A.2.d:
Where does the NRC anticipate that storage space, with protection from the elements and climate extremes, will be available at Callaway One for wastes collected during an indefinite number of future refueling and maintenance outages? I understand that the next refueling outage is scheduled for this fall, 2008.

Response:
It is AmerenUE's responsibility to identify the appropriate space to safely store Class B and Class C waste for an indefinite period of time.

Question A.3.a:
Questions about lessons learned from the events of 9/11 in 2001:

Has the NRC issued any generic regulatory changes as yet for the extended interim storage of low-level waste on site at nuclear power plants in order to address intensified security concerns, following 9/11?

Response:
The NRC has not issued any additional security requirements for extended storage of LLW as result of the events of September 11th of 2001. NRC requires licensees to secure licensed materials from unauthorized removal. The NRC staff is currently reviewing whether there is a need for any additional security requirements for the extended storage of LLW on licensees' sites. If the NRC determines that additional security requirements are necessary, appropriate Orders and Additional Security Measures (ASMs) will be issued to all affected licensees.

Question A.3.b:
Is it expected that the NRC will require additional armed security personnel at nuclear power plants because of the extended onsite storage and increased volume of primary and secondary LLW? Is the Commission addressing the possibility that a terrorist could seek to steal these stockpiled materials for use in making a dirty bomb?

Response:
LLW is currently being stored onsite safely and securely. Given the potential for extended storage of LLW, NRC is currently assessing the need for any additional security requirements for these storages.

Question A.3.c:
Does the NRC expect to require Ameren to submit any amendments to its operating license for Unit One in order to accommodate the extended storage of certain radionuclides of concern in quantities that may exceed threshold limits, now that Barnwell is closed to Missouri's B & C wastes?

Response:
Nuclear power plant licensees are authorized to store LLW without a specific limit on the amount of waste to be stored. Construction of new storage facilities requires a safety assessment and an evaluation under 10 CFR 50.59, compliance with GDC 61, compliance with Regulatory Guide 1.143, and documentation in the Final Safety Analysis Report. AmerenUE

would only have to submit a license amendment request if the licensee identified an unresolved safety question, or if extended storage of LLW were prohibited by the license or technical specifications.

Question A.4.a and A.4.b:
Questions about the potential generation of combustible gas combinations and other reaction products during the extended on-site storage of LLW:

a. Radiolysis is defined as the decomposition of water into hydrogen and oxygen gases as the result of exposure to the water molecules to radioactivity. Radiolysis has caused the decomposition of residual water in radioactive waste containers into potentially dangerous gas combinations. Does the NRC expect to require Ameren to install and operate "additional ventilation, air filtration, or fire detection/alarm/protection/suppression systems" in order to seek protection against the increased potential for radiolytically generated combustible gases (RIS 2008-12, p.4).

b. During the train shipments of the irradiated fuel that had melted during the 1979 accident at Three Mile Island (that is, shipments that were routed from Pennsylvania, through St. Louis, to a storage pool in Idaho), recombiner catalyst packages were installed in each of the fuel transport canisters in order to recombine hydrogen and oxygen gases that were separated by the radiolytic decomposition of residual water in the canisters. The NRC was concerned both about the buildup of internal pressure and about the buildup of potentially flammable or explosive mixtures of hydrogen and oxygen.

Since Callaways' hottest wet and dry LLW will now merely be piled up or stacked in drums in a building at Callaway, is the NRC planning to address the hazards of radiolytically-generated gases that might accumulate during the extended storage duration?

Response for a and b:
AmerenUE must perform an evaluation of proposed changes to LLW storage procedures in accordance with 10 CFR 50.59 to determine if radiolytically-generated combustible gases will affect the safe operation of the plant and safe storage of LLW. If radiolytically-generated combustible gases resulting from the extended storage of LLW will impact the safe operation of the plant and safe storage of LLW, then AmerenUE will have to appropriately address the issue.

Question A.5.a and A.5.b:
Questions about the monitoring of the stored low-level wastes:

a. Is remote-controlled monitoring equipment currently available that can determine if concentration levels of radioactive gases, liquids or particulate materials released to the environment from B & C wastes in the Drum Storage Annex may exceed the NRC's permissible emission levels?

b. If such equipment is not available, is the NRC concerned about the health and safety of workers who may have to enter the storage building in order to measure the surface dose rates and leakage rates of the stored materials? Could operating and maintenance tasks become necessary inside the building to remediate leakage, repackage wastes, and reduce excess releases of radioactive wastes to the environment? Could the workers be placed at risk from elevated levels of radiation --- for example, by having to work within high radiation fields?

Response for a and b:
Part of the NRC's mission is to protect the health and safety of workers, as such and routinely performs occupational radiation safety inspections. Regulations in 10 CFR Part 20, "Standards for Protection Against Radiation," specifically limit the dose workers are allowed to receive from occupational activities. Licensees are required to have a radiation protection program to ensure compliance with the regulations and must also ensure doses are as low as is reasonably achievable (ALARA). Licensees are also required to perform surveys which document the magnitude and extent of radiation levels, concentration or quantities of radioactive material, and potential radiological hazards. Remote monitoring equipment is available but licensees are free to choose the monitoring equipment that best suits their needs. During plant inspections, the NRC regional inspectors routinely review a licensee's radiation protection program.

Question B:
If the NRC fails to approve the Yucca Mountain site and/or its design, has the Commission determined the maximum number of years during which it would allow irradiated fuel rods to be stored within a nuclear power plant site, either in a reinforced-concrete spent fuel pool inside a plant building, or in dry storage casks outside in a fenced area?

Response:
The Commission addressed this very issue as part of its 1999 waste confidence review (64 Federal Register 68005). Based on this waste confidence review, the Commission found reasonable assurance that, if necessary, spent fuel can be stored safely and without significant environmental impact for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent-fuel storage installations.

Question C:
When does the NRC expect to complete its analysis and decision about the certification of Areva's proposed U.S. Evolutionary Power reactor (EPR) design (Ameren's choice for its proposed second reactor)? When does the NRC expect to issue the Final Environmental Impact Statement for the reference Areva EPR Plant (being considered for the Calvert Cliffs nuclear power plant site in Maryland, on Chesapeake Bay)? I stated I could not understand how an analysis of the environmental impacts of a proposed operating reactor could be assessed before the NRC had completed its analysis of that reactor's design, including its planned and anticipated accidental emissions of radioactive wastes to the environment. I am afraid I still do not understand the timing.

I was surprised, after the July 9 meeting, to be told by an NRC official that the NRC's analysis of a certification application for a new reactor design does indeed not include a study or calculations of that reactor's anticipated releases of radioactive materials in gaseous and liquid effluents. I would have thought that the certification process would have included detailed specifications about the reactor design's proposed radioactive waste management systems, structures, and components – and calculations or estimates of the reactor's planned and unplanned radioactive effluents. How else would the NRC be able to assess whether the reactor would be able to comply with the NRC's regulations designed to protect the health and safety of the public and plant operating personnel, and with the EPA's radiation standards?

Response:
On December 11, 2007, AREVA submitted an application to the NRC for a standard design certification of the U.S. Evolutionary Power Reactor (EPR). By letter dated February 25, 2008, the NRC staff docketed the application and subsequently published a schedule for the detailed

review of the application on March 26, 2008 (ADAMS accession number ML080790431). The safety review supports the issuance of a Final Safety Evaluation Report by May 2011. However, the schedule will be revisited when the Safety Evaluation Report with open items is issued. At that point, the staff may establish new milestones based on the number and complexity of the open items.

On July 24, 2008, Union Electric Company doing business as AmerenUE submitted a combined license application to the NRC for one new reactor unit at the Callaway site. The application has not been accepted for docketing yet, and therefore schedules for the environmental and safety reviews have not been determined. The staff will determine acceptability of the combined license application on the basis of technical sufficiency as well as its completeness within a period of 60 days from the date of submittal. The new reactor environmental review process is estimated to take 24 months from the date of acceptance of an application to the issuance of a Final Environmental Impact Statement (EIS).

As indicated in your letter, it is likely that if the Callaway application is accepted for docketing the Final EIS will be published before the standard design certification review for the EPR is complete. However, the NRC is able to assess the environmental impacts of the proposed reactor, including any effluent releases to the environment, in the absence of a design certification. The staff conducts an environmental review according to NUREG-1555, Environmental Standard Review Plan. As outlined in NUREG-1555, the staff also conducts a review and evaluation of the applicant's proposed radiological environmental monitoring program. The scope of the environmental review includes a determination of the expected quantity of radioactive material released annually resulting from normal operations and an assessment of the proposed radioactive waste management systems to maintain releases ALARA. A description of the radioactive waste management systems and estimated effluent releases are contained in Chapter 11 of the design certification application for the EPR, and this preliminary information is used to conduct the effluent release portion of the environmental review. However, please be aware that, regardless of plant design, any radiation dose from effluents released from an operating nuclear power plant must comply with regulations as set forth in 10 CFR Part 50 Appendix I and 10 CFR Part 20, "Standards for Protection Against Radiation." If a combined license is issued for Callaway, the licensee will be held to these radiation standards. An assessment of the environmental impacts related to accidents is conducted according to NUREG-1555, Chapter 7, and will be addressed in the Final EIS. Because the design certification review for the EPR will still be ongoing by the time the Callaway Final EIS is published, the NRC's final decision on issuance of a combined license for Callaway will not be made until the design certification review for the EPR is complete.

Question:
I have read a great deal about tritium since then and have learned that it is indeed hazardous. I have also learned that no economically feasible technology exists to filter tritium from the gaseous emissions or from the thousands of gallons per minute of liquid wastes released to the cooling water source (river, lake or ocean) from a nuclear power plant. And since that tritium cannot be filtered, it is not required to be filtered during the reactor's routine operation, including impacts from natural phenomena and anticipated operational occurrences—that is, external man-induced and design basis accidents. Tritium had not been included in the list of gaseous releases to the environment, in the NRC's 1975 Final Environmental Statement (p. 3-16). But by the time of the NRC's 1981 Safety Evaluation Report, approximately 1000 curies of tritium had been added to the calculated annual gaseous releases from the radwaste system and building ventilation systems. (pp. 11-4, -11). I also understand that tritium and other weak beta emitters cannot be monitored accurately in continuous-flow liquid releases, nor during

continuous-flow gaseous ventilation and purging. (A valve is opened when the containment building is vented, while purging requires a fan).

Response to Tritium Concern:
Releases from nuclear power plants (including Callaway) are regulated by the NRC to protect the health and safety of the public. All routine effluent releases must be in compliance with the regulations in 10 CFR Part 20. Also, nuclear power plants must meet the dose objectives specified in Appendix I of 10 CFR Part 50. By meeting the dose objectives in Appendix I, the doses from liquid and gaseous effluents are considered to be ALARA. Licensees submit annual effluent reports and these reports are reviewed by NRC regional inspectors.

Typical releases of tritium in gaseous effluents from a nuclear power plant (like Callaway) are much less than 0.1 mrem per year. To put this into context, the average American receives about 300 mrem of radiation exposure each year from the combination of (1) natural sources of radiation and (2) medical tests (dental x-rays, diagnostic tests, etc.). In other words, the dose from tritium (in gaseous releases from Callaway) is 3000 times less than the natural background, and is not considered a significant health risk to the public.