Research Reactor Center
University of Missouri-Columbia

Research Park
Columbia, MO 65211

PHONE (573) 882-4211
FAX (573) 882-6360

January 29, 2010

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Mail Station P1-37
Washington, DC 20555-0001

REFERENCE: Docket 50-186
University of Missouri – Columbia Research Reactor
Amended Facility License R-103

SUBJECT: Written communication as specified by 10 CFR 50.4(b)(1) regarding the response to the "University of Missouri at Columbia – Request for Additional Information Re: License Renewal Environmental Report (TAC No. MD3034)," dated December 30, 2009

On August 31, 2006, the University of Missouri-Columbia Research Reactor (MURR) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) to renew Amended Facility Operating License R-103.

On December 30, 2009, the NRC requested additional information and clarification regarding the renewal request in the form of four (4) questions. Those questions, and the MURR's responses to those questions, are attached. If there are any questions regarding this response, please contact me at (573) 882-5276. I declare under penalty of perjury that the foregoing is true and correct.

Sincerely,

Leslie P. Foyto
Reactor Manager

ENDORSEMENT:
Reviewed and Approved,

Ralph A. Butler, P.E.
Director

Enclosed: Report on Compliance with the Clean Air Act Limits for Radionuclide Emissions from the Comply Code – V1.6, prepared April 15, 2009

xc: Reactor Advisory Committee
Reactor Safety Subcommittee
Dr. Robert Duncan, Vice Chancellor for Research
Mr. Craig Basset, U.S. NRC
Mr. Alexander Adams, U.S. NRC

NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI

MARGEE P. STOUT
My Commission Expires
March 24, 2012
Montgomery County
Commission #08511436

Margee P. Stout

1. *Your environmental report was submitted as part of your license renewal package in 2006. Please discuss any changes that have occurred since submission of the report or any additions to information needed to reflect the passage of time since submission.*

The following is a list of changes and additions to information to the Environmental Report since submission in 2006.

Page 1-1 Ho-166-DOTMP is no longer produced at MURR.

Page 1-10 In the summary of results relating to the issue of "Refurbishment impacts," there is mention of a planned building addition. Construction of this new 30,300 ft^2 building addition – designated as the North Office Addition – has now been completed. The building consists of offices, some additional laboratory space and a 16 MeV cyclotron, and its support equipment. No activities associated with operation of the reactor are conducted in this building.

Page 2-6 In Section 2.4, "Operational Boundaries," it states that the operations boundary consists of the outer walls of the Research Reactor Facility (laboratory and reactor containment buildings) and the adjacent cooling tower. The operations boundary now consists of the outer walls of the Research Reactor Facility (north office addition, and laboratory and reactor containment buildings) and the adjacent cooling tower and shipping and receiving building. A new 3,127 ft^2 shipping and receiving building was constructed on the 7.5 acre facility lot to enhance security at the facility. Incoming and outgoing packages are received and staged for shipment in this building such that transport vehicles are not required to enter the gated parking lot which surrounds the facility.

Page 3-3 The two (2) tube-type, water-to-shell primary coolant heat exchangers have been replaced by two (2) water-to-water plate-type heat exchangers.

Page 3-4 The two (2) lined carbon steel 7,000 gallon demineralized make-up water storage tanks have been replaced with two (2) stainless steel tanks.

Page 3-9 In Section 3.5, "Employment," there is also mention of a building addition. As described above, construction of this building has now been completed.

The Environmental Report states in several places (pages 1-14, 3-5, 4-13, 4-25 and 4-32) that there is no radioactive waste stored permanently on site. This was accurate at the time the report was prepared and we still do not intend to store waste on site permanently. However, the restriction of access to the Barnwell waste site in 2008 has left MURR with no options for disposal of Class B and C waste. Under normal circumstances MURR makes a shipment of Class B waste approximately every two years. These shipments primarily contain activated metal components produced as a result of normal reactor operations. MURR now maintains these materials in temporary long term storage within the reactor facility until permanent disposal options become available. The Texas Low Level Radioactive Waste Disposal Compact Commission is currently considering rulemaking changes that would allow for the importation of limited quantities of waste from other waste compacts. If these changes are adopted, MURR will explore the possibility of using that facility for permanent disposal.

2. *Section 4.2.8. Please provide data for the last 10 years for annual person-rem per group, average annual individual dose per group, and the maximum annual individual dose per group. Your groups should account for all persons badged.*

Year 2009[1] Group	Annual Person-Rem	Average Annual Individual Dose (mrem)	Maximum Annual Individual Dose (mrem)
Analytical Chemistry Services[2]	0.544	41.8	165
Director's Office	0.243	9.0	42
Facility Support Operations	1.327	37.9	339
Hot Cell/Shipping	3.493	436.6	832
Regulatory Assurance Group	2.247	149.8	689
Irradiations	0.089	22.3	58
Nuclear Analytical Analysis	0.349	24.9	86
Neutron Scattering	0.495	30.9	128
Reactor Operations	13.841	532.3	809
Isotope Production	1.053	210.6	353
Research[2]	0.257	8.0	41
Radiopharmaceutical	1.192	47.7	128
Silicon	0.744	186.0	358

Note 1: 2009 data reflects cumulative dose through November 2009.
Note 2: Analytical Chemistry Services group was spilt into the Analytical Chemistry Services and Research groups in 2009.

Year 2008 Group	Annual Person-Rem	Average Annual Individual Dose (mrem)	Maximum Annual Individual Dose (mrem)
Analytical Chemistry Services	1.224	27.2	243
Director's Office	0.443	16.4	34
Facility Support Operations	1.347	35.4	117
Hot Cell/Shipping	4.854	606.8	991
Regulatory Assurance Group	2.947	196.5	803
Irradiations	0.206	51.5	142
Nuclear Analytical Analysis	0.628	44.9	133
Neutron Scattering	0.84	49.4	303
Reactor Operations	17.571	702.8	1140
Isotope Production	1.208	302.0	399
Radiopharmaceutical	1.105	44.2	135
Silicon	2.534	332.5	686

Year 2007 Group	Annual Person-Rem	Average Annual Individual Dose (mrem)	Maximum Annual Individual Dose (mrem)
Analytical Chemistry Services	0.913	24.0	237
Director's Office	0.336	14.0	60
Facility Support Operations	1.589	46.7	172
Hot Cell/Shipping	4.427	553.4	787
Regulatory Assurance Group	2.457	163.8	625
Irradiations	0.321	64.2	198
Nuclear Analytical Analysis	0.363	33.0	72
Neutron Scattering	1.089	60.5	291
Reactor Operations	18.448	709.5	1241
Isotope Production	1.423	237.2	452
Radiopharmaceutical	0.713	26.4	73
Silicon	1.497	374.3	682

Year 2006 Group	Annual Person-Rem	Average Annual Individual Dose (mrem)	Maximum Annual Individual Dose (mrem)
Analytical Chemistry Services	0.354	11.8	51
Director's Office	0.522	22.7	158
Facility Support Operations	2.656	37.4	460
Hot Cell[1]	0.920	NA	NA
Regulatory Assurance Group	2.668	166.8	637
Irradiations	0.341	68.2	207
Nuclear Analytical Analysis	0.266	22.2	65
Neutron Scattering	0.426	28.4	143
Reactor Operations	18.971	729.7	1146
Isotope Production	0.647	161.8	274
Radiopharmaceutical	1.025	36.6	135
Shipping[1]	3.461	494.4	673
Silicon	1.550	387.5	768
Special Project[2]	0.013	1.3	10

Note 1: Hot Cell and Shipping groups were combined into one group named Shipping in August 2006.
Note 2: Special Project group ceased operation at MURR during May 2006.

Year 2005 Group	Annual Person-Rem	Average Annual Individual Dose (mrem)	Maximum Annual Individual Dose (mrem)
Analytical Chemistry Services	0.269	10.8	83
Director's Office	0.207	9.9	124
Facility Support Operations	2.165	50.3	342
Hot Cell	2.781	927.0	1296
Regulatory Assurance Group	2.371	158.1	469
Irradiations[1]	0.942	235.5	470
Nuclear Analytical Analysis	0.138	9.9	42
Neutron Scattering	0.299	17.6	234
Reactor Operations	18.187	673.6	1038
Isotope Production	0.707	235.7	235
Radiopharmaceutical	0.786	35.7	168
Shipping	1.702	283.7	664
Silicon[1]	1.019	254.8	901
Special Project	0.035	5.0	4

Note 1: Two members of the Irradiations staff were transferred to the Silicon group in 2005.

Year 2004 Group	Annual Person-Rem	Average Annual Individual Dose (mrem)	Maximum Annual Individual Dose (mrem)
Analytical Chemistry Services	0.559	29.4	71
Director's Office	0.187	8.9	76
Facility Support Operations	1.306	29.0	224
Hot Cell	1.883	470.8	669
Regulatory Assurance Group	1.944	121.5	566
Irradiations	0.577	144.3	362
Nuclear Analytical Analysis	0.351	31.9	58
Neutron Scattering	0.653	36.3	207
Reactor Operations	16.202	600.1	1529
Isotope Production	1.029	205.8	333
Radiopharmaceutical	0.784	31.4	131
Shipping	0.931	155.2	366
Silicon	0.624	208.0	555

Year 2003 Group	Annual Person-Rem	Average Annual Individual Dose (mrem)	Maximum Annual Individual Dose (mrem)
Analytical Chemistry Services	0.483	24.2	65
Director's Office	0.205	9.3	96
Facility Support Operations	1.759	46.3	192
Hot Cell	1.907	476.8	639
Regulatory Assurance Group	1.922	137.3	407
Irradiations	0.359	89.8	123
Nuclear Analytical Analysis	0.319	35.4	111
Neutron Scattering	0.753	57.9	302
Reactor Operations	15.267	610.7	1078
Isotope Production	1.932	386.4	675
Radiopharmaceutical	0.829	59.2	147
Shipping	0.698	139.6	243
Silicon	0.449	149.7	419

Year 2002 Group	Annual Person-Rem	Average Annual Individual Dose (mrem)	Maximum Annual Individual Dose (mrem)
Analytical Chemistry Services	0.259	13.6	42
Director's Office	0.647	29.4	295
Facility Support Operations	1.387	46.2	328
Hot Cell	2.999	749.8	1127
Regulatory Assurance Group	4.766	297.9	1384
Irradiations	0.636	106.0	216
Nuclear Analytical Analysis	0.231	25.7	74
Neutron Scattering	0.528	40.6	134
Reactor Operations	17.762	634.4	1104
Isotope Production	1.863	186.3	599
Radiopharmaceutical	1.407	93.8	503
Shipping	0.888	177.6	357
Silicon	0.486	162.0	471

Year 2001 Group	Annual Person-Rem	Average Annual Individual Dose (mrem)	Maximum Annual Individual Dose (mrem)
Analytical Chemistry Services	0.076	4.8	34
Director's Office	0.572	19.1	190
Facility Support Operations	2.008	57.4	440
Hot Cell[1]	3.790	947.5	1330
Regulatory Assurance Group	6.255	417.0	1500
Irradiations[2]	0.761	84.6	370
Nuclear Analytical Analysis	0.248	24.8	40
Neutron Scattering	0.570	24.8	100
Reactor Operations	20.120	693.8	1640
Isotope Production	3.363	177.0	614
Radiopharmaceutical	1.975	179.5	884
Shipping[1]	2.570	642.5	810
Silicon[2]	0.530	265.0	530

Note 1: Hot Cell/Shipping group was split into the Hot Cell and Shipping groups in 2001.
Note 2: Silicon group was split into the Irradiations and Silicon groups in 2001 after the topaz program was restructured.

Year 2000 Group	Annual Person-Rem	Average Annual Individual Dose (mrem)	Maximum Annual Individual Dose (mrem)
Analytical Chemistry Services	0.080	5.7	70
Director's Office	0.700	23.3	490
Facility Support Operations	2.070	64.7	480
Regulatory Assurance Group	6.310	525.8	1930
Nuclear Analytical Analysis	0.050	4.5	10
Neutron Scattering	0.510	18.2	160
Reactor Operations	19.680	787.2	1510
Isotope Production	4.460	297.3	1340
Radiopharmaceutical	2.780	308.9	830
Hot Cell/Shipping[1]	6.500	812.5	1830
Silicon/Topaz[2]	3.540	208.2	1610

Note 1: Hot Cell and Shipping groups were combined into the Hot Cell/Shipping group in 2000.
Note 2: Silicon and Topaz groups were combined into the Silicon/Topaz group in 2000.

3. *Section 4.2.11.2, Liquid Waste. This section states that liquid waste is filtered until no suspended solids of a visible size remain prior to release to the sanitary sewer. Please discuss how this method complies with the requirements of 10 CFR 20.2003(a)(1).*

10 CFR 20.2003(a)(1) states that "A licensee may discharge licensed material into sanitary sewerage if...the material is readily soluble (or is readily dispersible biological material) in water."

NRC Information Notice 94-07, "Solubility Criteria for Liquid Effluent Release to Sanitary Sewerage Under the Revised 10 CFR Part 20," was issued on January 28, 2004 to emphasize the changes in 10 CFR Part 20 with respect to liquid effluent release to sanitary sewerage and to encourage licensees to prepare for these revisions. IN No. 94-07 provided two of the more rigorous approaches to determine a chemical compound's solubility in water: (1) Direct Determination of Compound Solubility Class, Formal Solubility, or Solubility Product (Ksp), and (2) Filtration and Radiometric Analysis of Suspended Solids. IN No. 94-07 also stated "Whether one of the above approaches or a self developed alternative is used, it is a good health physics practice to document this approach in the form of a procedure. Procedures such as these annually include provisions for documentation of any models, calculations, analytical measurements, and/or quality control measures used. This information is usually maintained with the applicable release records, to demonstrate that the developed procedure will ensure compliance with the regulations."

American National Standard ANSI/ANS-15.11-1993 (reaffirmed May 27, 2004), "Radiation Protection at Research Reactor Facilities," defines soluble material as "having no significant visible turbidity or significant visible suspended solids so as not to change the characteristics as a solution, e.g., so as not to have the characteristic of a sludge."

MURR Operating Procedure OP-RO-741, "Waste Tank System Operation," provides procedural steps and precautions to operate and sample radioactive liquid waste while in retention within the MURR Waste Tank System and prior to disposal from the system. Prior to sampling, the waste water is recirculated through 0.5-micron filters for a minimum of twelve (12) hours. The water is then sampled and if any suspended or settled solids can visibly be seen in the sample, the water is recirculated again until no suspended or settled solids can be seen.

Experience shows that by filtering the waste water a minimum of twelve (12) hours through 0.5-micron filters, and then using the definition of soluble material as stated in ANSI/ANS-15.11 when sampling, we comply with the requirements of 10 CFR 20.2003(a)(1).

4. *Section 5.1. This section states that the results of a run of the COMPLY code is an appendix of the environmental report. The appendix appears to be missing. Please provide a copy of the latest run of the COMPLY code.*

Enclosed you will find the results of the most recent run of the COMPLY code, which was performed for calendar year 2008.

COMPLY: V1.6. 4/15/2009
4:10

40 CFR Part 61
National Emission Standards
for Hazardous Air Pollutants

REPORT ON COMPLIANCE WITH

THE CLEAN AIR ACT LIMITS FOR RADIONUCLIDE EMISSIONS

FROM THE COMPLY CODE - V1.6.

Prepared by:

Research Reactor
Research Reactor
Columbia, MO 65211

Ron Dobey, CHP
573 882-5218

Prepared for:

U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Washington, DC 20460

COMPLY: V1.6. 4/15/2009
4:10

University of Missouri

SCREENING LEVEL 4

DATA ENTERED:

Nuclide		Release Rate (curies/YEAR)
AR-41		1.250E+03
C-14	1	1.070E-02
CE-144	Y	8.010E-06
CO-60	Y	1.820E-05
I-131	D	7.240E-05
H-3	V	8.540E+00
K-40	D	4.550E-05
SC-46	Y	3.060E-06
I-125	D	2.880E-06
SN-113	W	3.160E-06
ZR-95	D	8.700E-07
CS-137	D	3.120E-07
GD-153	D	4.640E-07
BA-140	D	2.280E-06
CE-141	Y	3.670E-07
I-133	D	1.150E-04
HF-181	D	1.750E-07
BE-7	Y	8.330E-06

Release height 21 meters.

Building height 16 meters.

The source and receptor are not on the same building.

Building width 48 meters.

Building length 77 meters.

STACK DISTANCES, FILE: E:WINDROSE

DIR	Distance (meters)
N	760.0
NNE	150.0
NE	150.0
ENE	250.0
E	250.0
ESE	850.0
SE	800.0
SSE	800.0
S	130.0
SSW	600.0
SW	900.0
WSW	1250.0
W	1600.0
WNW	1100.0
NW	950.0
NNW	600.0

WINDROSE DATA, FILE: E:MURRWindRose.dat

Source of wind rose data: Callaway NGS
Dates of coverage: 1985-1990
Wind rose location: Fulton, MO
Distance to facility: 33 miles

Percent calm: 0.00

Wind FROM	Frequency	Speed (meters/s)
N	0.030	3.58
NNE	0.040	2.78
NE	0.040	2.41
ENE	0.036	2.57
E	0.046	2.86
ESE	0.051	2.80
SE	0.095	2.97
SSE	0.104	3.16
S	0.110	3.48
SSW	0.072	3.52
SW	0.066	3.36
WSW	0.044	3.23
W	0.062	3.39
WNW	0.073	3.55
NW	0.068	3.51

NNW	0.063	3.39

Distance from the SOURCE to the FARM producing VEGETABLES is 2000 meters.

Distance from the SOURCE to the FARM producing MILK is 2000 meters.

Distance from the SOURCE to the FARM producing MEAT is 2000 meters.

NOTES:

The receptor exposed to the highest concentration is located 150. meters from the source in the NNE sector.

He gets his VEGETABLES from a farm located 2000. meters from the source in the NNW sector.

He gets his MEAT from a farm located 2000. meters from the source in the NNW sector.

He gets his MILK from a farm located 2000. meters from the source in the NNW sector.

Input parameters outside the "normal" range:

Stack file distance is unusually FAR.

RESULTS:

Effective dose equivalent: 4.1 mrem/yr.

Effective dose equivalent: 5.0E-05 mrem/yr due to Iodine.

*** Comply at level 4.

This facility is in COMPLIANCE.

It may or may not be EXEMPT from reporting to the EPA.

You may contact your regional EPA office for more information.

********** END OF COMPLIANCE REPORT **********